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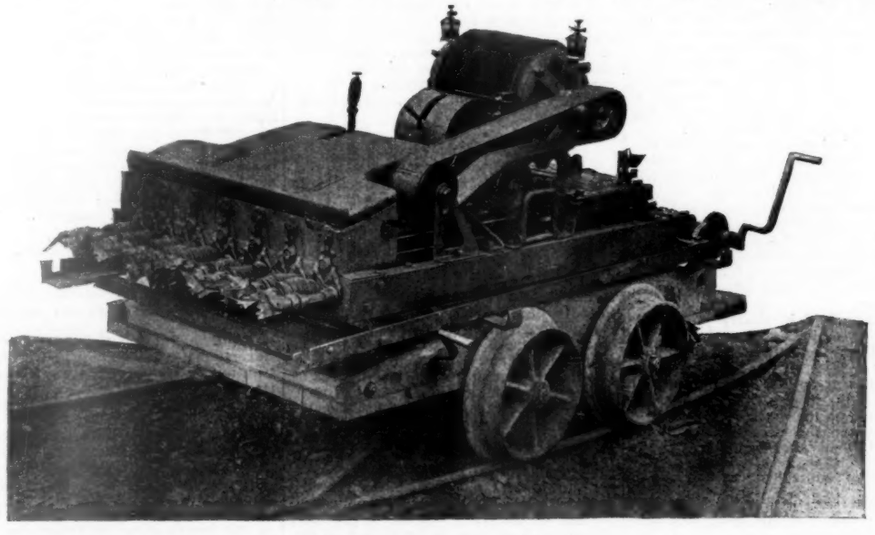
Electric Cooking.

State Chemist Dr. Charles W. Drew and Edward R. Francis gave an interesting exhibition of heating and cooking by electricity in Minneapolis, last week, which was attended by quite a number of local electricians. The methods of heating water for stewing and boiling were particularly noticed by the spectators, as well as the oven for heating purposes alone. Dr. Drew placed a piece of cardboard over the aperture at the top of the oven, and by applying the thermometer, the temperature was found to reach over 400 degrees, while that of the toasting apparatus, which is the latest invented article of the outfit, forced the mercury to 320 degrees. The workings were practically illustrated with the ordinary kitchen supplies and proved very satisfactory, the heating oven, however, seeming to be the best perfected arrangement. Some further additions are to be made to several portions of the apparatus, which will make them of especial use for the general purposes intended. Patents have been issued to Messrs. Drew and Francis for their appliances.



THE TESLA MOTOR IN COAL MINING.

The Alternating Current Motor in Mining Work.

The alternating current system of electrical distribution has just demonstrated its usefulness in a new field by proving a wonderful success in mining work.

The Willock mine, belonging to the Monongahela Gas Coal Company, and situated in the first pool of the Monongahela coal regions, is now operated by a complete plant of alternating current motors, utilized as the power in the production of coal, the working of the pump, and also in the manipulation of an enormous ventilator which keeps a constant draught of pure air in the mine. In addition to that, the mine is also illuminated by the alternating current system.

Inasmuch as this is the first mine in the Pennsylvania coal region where the alternating current system is utilized very extensively, your correspondent made a visit to the mine in order to make a personal investigation of the success of the plant. He was very much aided in his efforts through the courtesy of Mr. John Werner, the mill boss, a man who is himself a mechanical genius of ability. During a conversation with him, he said: "I believe that electric mining has no greater prospects anywhere than just in the coal fields of Pennsylvania. The reasons for this are so many that I hardly know where to commence to enumerate them. Coal mining in Pennsylvania was never such a poor trade as it is now, in fact, it is so bad that a native born American will have nothing more to do with the work. The result has been that the business has fallen into the hands of foreigners of the very lowest class, such as Hungarians, Poles and Italians. Then again, the price of coal has gone down to such an extent, induced, of course, by competition, that it is impossible to get many intelligent men who will do the work for the small wages a miner is able to make. This condition of affairs caused the coal operators to hail the advent of electricity as a coal miner with great delight, and I believe that it will not be very long before every mine in the country will be operated by electricity. The advantages afforded by electricity in the operation of a mine are so manifold that its use is bound to become general. For instance, where a coal digger was able to earn on the average $2.25 per day, the machine miner makes $3. Why? Because while the operator pays the miner less for the production of each ton of coal, the man can produce so much more with the aid of his machine that he can make better wages now and the work is less laborious. The operator pays the coal digger 79 cents per ton of coal; but the production of each ton with the aid of electricity costs him only 49 cents, so you see there is a pure gain for the operator of 30 cents for each ton."

The plant consists of a 30 horse-power quarter phase generator of a capacity sufficient to carry seven motors when cutting coal, at the limit of the capacity of the coal company. The generator is self-exciting, self-regulating, and so wound that as the load increases, the E. M. F. rises. By the aid of a hand rheostat, the adjustments can be so made that the falling off in the speed of the engine and the drop in the line may be compensated for so that at the motors a very close approximation to constant E. M. F. is obtained. After the hand rheostat is once adjusted, it is unnecessary to make further adjustments, for the self-regulating devices are automatic. Three wires are carried from the collector at the end of the generator shaft to the switchboard, and pass through the switchboard instruments and main line switches directly into the mine. On the switchboard is a direct reading voltmeter and an ammeter. The E. M. F. at the motor is 300 volts.

Where the distances become very great, a higher E. M. F. may, of course, be used. The mine is wired with high class rubber covered wire, and the insulation of each wire is practically continuous from the time the wire leaves the main switch in the power house until it reaches the end of the circuit. At the entrance of each room, and also at convenient points throughout the mine, switches are located and safety catches inserted. This insures safety from short-circuiting, and also allows any portion of the circuit to be cut off from the generator without interfering with the work in other parts of the mine. From the switch in the room to the coal-cutting machine, the current is carried by a three-wire cable. This cable is highly insulated and covered with a protecting braid, which, though frequently allowed to lie on a damp floor and even in pools of water, yet always works well.

It is necessary only to have a jaw switch at the motor with which the circuit can be opened and closed. No regulator of any kind is used. The only auxiliary apparatus connected with the motor, with which the operator of the machine has anything to do, is the switch to turn the current on and off. The motor is completely covered, and the chance of getting a shock through careless handling is simply *nil*.

When Mr. Werner expressed himself as highly pleased with the Tesla motor, he said: "Miners are not usually educated for electricians, and, in consequence, they want to handle a motor without having to go through a course of lectures and instructions. Here we have no brushes and no commutators, very valuable advantages, because those things get out of order, or else the man gets into close contact with them. The Tesla motor is also more efficient than any other we have ever tried. With it our men bring out from 45 to 50 tons of lump coal with each machine per day."

The coal mining machine used in this mine is the Hercules machine.

ELECTRICAL EXECUTION A FAILURE.

KEMMLER FINALLY KILLED, BUT REPEATED SHOCKS NECESSARY.—HIS HEAD AND BACK HORRIBLY BURNED.—THE OPINION IS THAT THIS ENDS ELECTRICAL EXECUTION.—COMMENTS OF THE PRESS AT HOME AND ABROAD.

William Kemmler, the murderer, who, for over a year, has been confined in prison, was killed by electricity at Auburn, N. Y., at 6.40 o'clock, the morning of August 6th.

After the death warrant had been read to him in his cell by Warden Durston, they walked to the execution chamber accompanied by two ministers. Here were assembled the following witnesses: Louis Balch, W. J. Nellis, J. M. Jenkins, W. T. Jenkins, Joseph Fowler, Henry A. Argue, C. M. Daniels, A. P. Southwick, C. R. Huntley, H. E. Allison, T. K. Smith, Robert Dunlap, E. C. Spitzka, Carlos F. MacDonald, George E. Fell, Oliver A. Jenkins, Tracy C. Becker, Michael Conway, George G. Bain, Frank W. Mack, George F. Shrady and George W. Irish.

Kemmler, after a few preliminaries, was firmly strapped in a large oak chair. An electrode, formed of a rubber cup containing a sponge wet with sodium chloride, and the whole fastened to a figure 4 arrangement secured to the back of the chair, was pressed down upon a spot on the murderer's head, from which the hair had been closely cropped. The other electrode was similar in construction, but was attached to a stiff spring which projected upward from the seat of the chair. This was placed in contact with the bared skin at the base of the spine.

A broad leather bandage was tightly drawn across Kemmler's face, and, shortly after, Warden Durston gave a pre-arranged signal to some unknown person stationed at the switchboard in an adjoining room. This person immediately threw the switch and closed the circuit. A sudden contraction of the muscles in the murderer's face, a gripping of the hands, and the whole body hunched up as much as the tight bindings would permit.

Thus the body remained for 17 seconds, when the physicians announced that the man was dead, and the Warden gave the signal to break the circuit. To the horror of all present, the chest began to heave, foam issued from the mouth, and the man gave every evidence of reviving. These manifestations were accompanied by hoarse breathings, as if respiration were returning.

The signal was again given to close the circuit, but something like two minutes elapsed before the current began to flow, as the engines had been signaled to stop, and it required that time to get up speed. During this nerve-destroying interval the harrowing occurrences mentioned above continued. Finally, the current was again sent

into the body in repeated shocks as the circuit was made and broken. At each shock the body twitched and jumped as much as the fastenings would allow.

Presently, smoke was noticed curling upward from the two points of contact. A pungent and sickening odor of burning flesh and hair filled the room. The correspondent of the United Press fainted away. The other witnesses were horror-struck. At last the current was shut off, the straps removed and the tense muscles partly relaxed, allowing the body to sink in the chair like a bundle of rags.

The current fluctuated between 700 and 1,800 volts, according to the majority of witnesses.

At the post-mortem examination it was noted that the blood corpuscles had undergone a crystalline transformation, and that the blood was watery.

What the People Say.

The sentiment expressed generally is that the Auburn horror ends electrical execution. The daily press has been full of interviews, and nearly all the speakers favor the repeal of the present law.

The physicians present as witnesses are indulging in disparaging remarks about each other, and there seems to be an effort on the part of all who had anything to do with the execution to shift the responsibility of the failure.

Mr. Charles R. Huntley, Chairman of the Executive Committee of the National Electric Light Association, and a prominent electric light man of Buffalo, was present by invitation as a witness to the execution. Some of the papers stated he was present to assist, which is erroneous, as he, as it is not necessary to state to those who know him, would have nothing to do with such work.

INTERVIEW WITH MR. HUNTLEY.

In an interview telegraphed to the *Sun*, of this city, Mr. Huntley is reported as follows:

"It was one of the most horrifying sights I ever witnessed or ever expect to witness. No money would tempt me to go through the experience again. The picture of it has been with me ever since, and I can still hear the groans of Kemmler when he was coming to after the first shock, the saliva bursting through his lips making a loud sound. I will see that bound figure and hear those sounds until my dying day."

"Will you describe those sounds?"

Mr. Huntley breathed deeply, throwing out his chest to the fullest extent, and making a sonorous sound like a deep groan. Then, as he expelled his breath, he blew through his lips, making such a sound as a person does in a convulsion.

"Were the sounds very loud?"

"Quite loud. We were in a room about 25 feet long and 18 feet wide, and the sounds were perfectly audible all over it."

"Was Kemmler alive at the time?"

"Certainly, he was. Some of the doctors said the respirations were the result of contraction of the diaphragm or something else. Others said he was alive. But to me it was an absolute surety that the man was alive."

"And in agony?"

"That I could not tell. The doctors agree that he had no consciousness of pain, and I am quite willing to let the doctors settle that. I don't believe anybody not there can thoroughly appreciate the horror that came over us. I can never shake it off. Kemmler was the coolest, most collected man in the room. He was the admiration of us all. He didn't act like a martyr, either. His air was that of a man resigned to his fate. There was nothing particularly revolting in these preparations, nor was the result of the first shock revolting while the current held the body of Kemmler in rigor. There was one strong convulsion at first, and that was all. The promoters of electric execution were elated. But the horror came later when Kemmler showed signs of life."

"How much voltage was given him in the first shock?"

"I don't know, and, I presume, we will never know; but I do know, that in the next shock he was given the full strength of the machine. Two convicts were made to hold the belt on the machine. Another horrible thing came when Kemmler's flesh began to burn. The odor filled the room. Suppose Kemmler had been overpowered with terror of what was going to happen. Suppose he had resisted, fought and had finally been crushed down into the chair. That would have added ten-fold to the horror of the execution. I don't think such an electric execution will ever happen again."

INTERVIEW WITH DR. JENKINS.

Dr. W. T. Jenkins, of New York, made the autopsy, selected, Dr. E. C. Spitzka says, "because he is at the head of the profession in this line." In an interview, Dr. Jenkins describes the terrible scene in the following graphic manner:

"When Kemmler received the electric current, his body suddenly stiffened and became rigid. There was an effort to protrude the head and chest, which was prevented by the straps around those parts of the body. For 17 seconds this rigidity continued. Then the current was switched off. The body at once collapsed and sunk in a heap on the chair.

"After the current was shut off, respiration began. It could not have been mechanical, because a single expiration would have been the end of it from this cause. Neither could it have been the reflex action of the muscles after disturbance by the electric current, because in that case each respiration would have been weaker than the one preceding it, whereas, in Kemmler's case, each succeeding respiration grew stronger. So I can only conclude that the respirations were vital, and that Kemmler was alive after the first shock.

"The second shock was continued for about four minutes. It produced the same rigid appearances as the first. At the end of three and a half minutes, the death pallor first became apparent. The blood left Kemmler's hands and the visible part of his face. It was simply by observing the death pallor that the physicians determined that Kemmler was dead. There was no examination made of his heart or pulse.

"The post-mortem appearances of Kemmler's body did not differ materially from those of Feeks and others who were killed accidentally by electricity. They bore a close resemblance to those which appear in death by suffocation.

"The ventricles of the heart were empty, as in asphyxiation, but, on the other hand, the lungs were full of blood, which is not the case in death from suffocation. All the small blood vessels were distended.

"The blood was fluid. Whether this fluidity is caused by changes produced in it by the electric current, or whether it comes from non-oxygenation, as in asphyxia, is a point not yet determined.

"The electric current naturally chose the blood vessels and not the nerves for its main path. All the small blood vessels in the scalp underneath the electrode were charred more than the flesh surrounding them. The same charring of the blood vessels was seen near where the electrode was applied at the end of the spinal cord.

"To the naked eye the spinal cord was uninjured. So were the blood vessels around it, except near where the electric current entered and left the body.

"The brain immediately underneath the electrode was yellowish in color, and most of the fluid was evaporated out of it. It is a mistake to say that the sponges were dried out by the electric current, for I squeezed water out of both of them after the execution was over.

"One thing, I think, clearly proved by Kemmler's execution is, that the electric current follows the path of the blood vessels as that of least resistance. By placing the electrodes at both ends of the central nervous system, it was thought that the nerves would be the track of the electric current between the electrodes. But this appears to be a mistaken hypothesis."

WHAT MR. EDISON SAYS.

In an interview, Mr. Edison states that the electric charge should have been sent through the hands instead of the head. He says:

"The reason why contact by hand is so much more fatal than through the head is that electricity travels through the water in the human body. The true way to execute a criminal is to send the current through his body from one arm of the death chair to the other. The arms, hands and fingers are full of blood, which is a good conductor of electricity. Let the hands be properly cleansed and moistened, and the charge would pass through the heart, causing instant death."

WHAT MR. WESTINGHOUSE SAYS.

Mr. Geo. Westinghouse said: "It has been a brutal affair. They could have done better with an axe. My predictions have been verified. The public will lay the blame where it belongs, and it will not be on us. I regard the manner of the killing as a complete vindication of all our claims."

REMARKS BY OTHERS.

S. A. Duncan, ex-president of the National Electric Light Association, says the execution was a failure and was barbarous in the extreme. He contends that Kemmler was not rendered insensible by the first shock, and that he suffered excruciating agony.

Commodore Elbridge T. Gerry refuses to be interviewed on the subject of Kemmler's execution. Until he is called on to express an official opinion as a member of the commission, he will say nothing.

FRIED TO DEATH.

General Butler, when asked his opinion of the execution of Kemmler, said: "I think it was a cruel and unusual punishment, and one which never ought to be resorted to again under similar appliances. If the newspaper reports are correct, the man Kemmler never received any absolute shock. A sponge was put on his head and another on his back, and the electric current passed through him and flowed four minutes before he was dead. He was literally fried to death." General Butler is said to believe that the guillotine is the best instrument of judicial death.

ELECTRICIAN PREECE BELIEVES THAT KEMMLER DIED IN TORTURE.

Mr. Preece, chief electrician of the Post Office, London, in an interview recalled his denouncing electricity as a means of execution before the British Association, in 1889. The great difficulty lay in the absence of accurate knowledge as to what amount of electricity would be certain to produce death without torture. From a scientific point of view, the Kemmler execution was a failure. Beyond doubt, he suffered intense torture.

EDITORIAL COMMENTS OF THE PRESS OF NEW YORK.

The First and the Last.

[From the *Sun*.]

The first duty of the next legislature will be to repeal the electrical execution law and to restore the old method of administering the death sentence by hanging.

Scientific curiosity has been gratified sufficiently by this one awful experiment. The present generation is not likely to hear of another such scene of horrible uncertainty, unknown torture and heart sickening circumstances, as was witnessed yesterday morning by the assistants at the judicial experiment upon the body of William Kemmler. Civilization will find other lines on which to manifest its progress.

It may be taken for granted that public sentiment in New York will tolerate no further essays in this new experimental science of man-killing by electricity, pending the time when the law can be repealed in the name of the State's dignity and of the enlightened humanity of the nineteenth century.

Dead by Electricity.

[From the *Star*.]

Some allowance must be made for the nervousness of the officials, who were trying an experiment, and for the fact that nearly all the witnesses were in anything but a calm frame of mind. Until the specialists have had time to recover, and can give us their thoughtful conclusions, it is not possible to form a decided opinion regarding the practicability of this method of execution.

But enough has been developed to show that there is need for more investigation as to the potency and the certainty of the electrical current, and for the more reliable arrangement of the scientific apparatus, before electrical execution can be accepted as the wisest and most effective method for taking the lives of murderers.

It was with the wholesome desire that capital punishment shall be, as far as possible, devoid of cruelty and of unnecessary suffering that electricity was summoned to the aid of the law. Whether it can meet those ends must now be the subject of further scientific and legislative consideration.

Death by Electricity.

[From the *Tribune*.]

There are only the two possible methods that our civilization will sanction—electricity and the rope. It is only because we are so familiar with hanging that its utterly brutal conditions are tolerated. To witness the long and desperate struggles of a poor wretch, who is undergoing the slow process of strangulation, is to witness a spectacle of unspeakable horror.

It is probable that the spectacle of Kemmler's death was equally dreadful, but it is also probable that sensation fled at the first approach of the electric current. This execution cannot be regarded as anything more than an experiment, and as an experiment it was not a complete success. The current was not steady, and neither were the nerves of those who applied it. Unless there is something about the human constitution which supplies an unusual resistance to the electric fluid, no proper occasion existed for the burning of Kemmler's flesh.

That there will now be a loud outcry against the new law is to be expected, and probably all sorts of expedients will be resorted to to prevent another application of it. Such expedients ought not to succeed. While we cannot consider it settled that the law should endure, further tests of its desirability should be had.

A Bungling Experiment.

[From the *Times*.]

The hanging of a man in a clumsy and bungling fashion, such as has many times been witnessed, is a revolting spectacle. Putting him to death unskillfully by electricity is not more so, though the novelty of the operation itself and the mystery connected with the action of electricity on the human system make it appear more horrible at the moment.

Perhaps it would be unjust to assume that preparation was made for a failure of the apparatus at Auburn prison, but it is at least evident that inadequate preparation was made for its success. It seems to be admitted now that the apparatus was defective, and that it did not work properly.

All the "horror" of the execution was due to the fact that the first application of the current did not extinguish life, though at first it seemed to have done so instantly and without pain. The slight symptoms of reviving were naturally very distressing to the witnesses, and the delay in getting the current started again intensified their disquietude, which was not mitigated by the effects of continuing the current until there were indications of a burning of the flesh.

It would be absurd to talk of abandoning the law and going back to the barbarism of hanging, and it would be as puerile to propose to abolish capital punishment because the new mode of execution was botched in its first application.

Electric Execution.

[From the *World*.]

The first experiment in electric execution should be the last. Its result strongly condemns this method of putting criminals to death as very cruel and very shocking.

The theory of unconsciousness from the first moment of shock is at best a mere assumption. It was not sustained in Kemmler's case by outward indications. Apparently the man died in agony, by slow torture.

The effect upon the witnesses was sickening. The effect upon the public is still more shocking, chiefly because of the attempt to do this judicial killing by torture in secret, and to conceal the facts, whatever they might be, from the public, in whose name and by whose authority the killing was done. The folly and wickedness of that attempt are sufficiently emphasized by the result.

The electric execution law ought now to be repealed on all accounts. So long as it stands, convictions for capital offenses will be difficult to the point of impossibility. Juries will not willingly condemn men to death by torture. So long as capital punishment is maintained, old-fashioned hanging is good enough, provided it is administered by trained and skillful hangmen.

A Bungling Execution.

[From the *Herald*.]

In one respect, at least, the execution of Kemmler was a dismal and unfortunate failure.

It will fail to end the unparalleled controversy that has been waged over the substitution of the dynamo for the gallows. On the contrary, it must revive that controversy and give to it a vigor which it never had before.

The ghastly scenes witnessed in the death chamber of Auburn prison, scenes that sickened strong men used to sights of horror, are graphically depicted in our news columns.

When the deadly current was first turned on, the success of the experiment seemed to be assured. There was a sudden momentary convulsion of the victim and, apparently, all was over. In 17 seconds he was pronounced dead and the current was turned off. Death appeared to be instantaneous and painless.

But that was not the end. A minute later Kemmler gave horrifying signs of life, and the current was turned on for the second time to dispatch him.

Whether he was killed by the first or the last shock, the world will never know. On this point the doctors disagree. They agree only that he was unconscious from the instant the fatal current first touched him, and hence that his death was painless, if not instantaneous.

While yesterday's experiment was a failure in the sense we have mentioned, it does not show that this mode of inflicting the death penalty is not a success. The failure was due, not to the system, but to the bungling, inefficient way in which the execution was managed. The fault was with the doctors and the electricians.

Repeal the Law.

[From the *Evening World*.]

The press and the public alike cry out against any repetition of this scene, the possibility of which can only be removed by repealing the law of electric death. Every

promise that it held out has been falsified by the event.

In the name of justice, civilization and humanity, do away with it!

Most Cruel.

[From the *Mail and Express.*]

Electricity is the most cruel and horrible of executioners. That, at least, is demonstrated.

Burning at the Wire.

[From the *Press.*]

The people of New York State are not barbarians or cannibals. They do not want to put anybody, even the most desperate criminals, to death by methods of torture. They do not fancy the smell of burning human flesh. It was argued in behalf of this mode of execution that death was to be instantaneous, lightning-like, painless, and that the maudlin hero worship attending the dramatic march of the nervy murderer to the scaffold was to be done away with, and a secret and mysterious taking off, devoid of sensational features, to be substituted. The act even went so foolishly far as to prohibit the newspapers from publishing the details of such an execution—a prohibition which, by the way, they most properly and completely ignored yesterday.

But such executions as that of Kemmler would promote murder. They would prove tenfold more sensational than any hanging, and would make silly women send ten times as many flowers and tidbits to bloody-handed brutes as they do now. The possibility of such a horrible death would turn the worst of ruffians into a hero and a martyr; and if so simple an affair as a hanging is bungled now and then by ignorant executioners, how much oftener would the electrical apparatus be liable to work imperfectly, through defective preparation or handling?

It will never be known whether or no Kemmler suffered cruel agonies, but an enlightened community cannot afford to take any risks of that kind. The age of burning at the stake is past; let the age of burning at the wire pass also.

Severely Condemned by the British Press.

The London *Chronicle*, commenting upon the killing of Kemmler by electricity, says the scene was worthy of the darkest chambers of the Inquisition in the sixteenth century.

The *Times* says it would be impossible to imagine a more revolting exhibition. It advocates a lethal chamber in preference to the use of electricity.

The *Standard* says: "The scene can be described as a disgrace to humanity. It will send a thrill of indignation throughout the civilized world. We cannot believe that Americans will allow the electrical execution act to stand."

Dr. Shrady's Opinion.

[From the *Medical Record.*]

"The execution by electricity, the lengthened agony and suspension regarding the efficiency of electricity as a means of executing criminals, has finally terminated in the legal killing of William Kemmler. As was reasonably anticipated, death was instantaneous, and, so far as can be judged, the unfortunate subject of the experiment died without pain. The spectacle presented was, however, by no means edifying to such as hope for improvements of old methods.

"Although science has triumphed, the question of the humanity of the act is still an open one. But shall we call it a triumph when the object attained was the killing of a fellow being? Heretofore the proudest claim of science has been to save or at least prolong human life and insure for its possessor the greatest enjoyment of its many bounties. In this instance it has been plainly diverted from its course under a paradoxical plea of high humanity, and yet men of science have lent their best efforts in this direction to humor the whims of a few cranks and world betterers, who imagined they could make legal murder a fine art and infuse into it an element of sentimentality which might rob it of its atrocity. * *

"The experiences in the Kemmler case, in spite of all the precautions taken, have shown many difficulties in the way of a general adoption of the method. It is far from simple in its application. It requires elaborate and careful preparation. It necessitates machinery which, without expert manipulation, is liable to fail in its working and bring about disastrous results. It may be a source of danger to the executioners and spectators; it increases the expense of executions; but worse than all, in the necessary preparation of the victim, there is crowded upon him in a few seconds amounts of horror and suspense which hold no comparison with any other forms of rapid demolition, save those of being thrust into the muzzle of a loaded cannon or tied to a dynamite bomb.

"When it is assumed that the ends of justice and humanity are reached by the contrivance in question, and when it must be admitted that even this method cannot be divested either of cruelty or barbarity, the way seems to be open for the discussion of the abolition of capital punishment altogether. From physical, humanitarian and judicial standpoints, the time is ripe for its consideration. We venture to predict that public opinion will soon banish the death chair as it has done the rope, and that imprisonment for life will be the only proper punishment meted to a murderer. This is, indeed, the only rational method which science, justice and religion can consistently recommend. The death chair will yet be the pulpit from which this doctrine will be preached."

The West Lynchburg, Va., Land and Improvement Company has determined to construct an electric street car line around the whole city at as early a day as possible, and along the route where the most private subscriptions shall be made to the capital stock of $100,000.

New Sawyer-Man Lamp Factory.

The Sawyer-Man Lamp Factory, on West Twenty-third street, New York City, has recently been remodeled and, without doubt, is now one of the largest and best equipped plants for the purpose in the world.

The whole building has been strengthened by iron columns and braces running from heavy stone piers in the basement clear up to the roof. Wide skylights running the entire length of the building, add greatly to the light and comfort of the lamp room on the top floor. There is of necessity considerable heat on this floor, owing to the large number of gas jets used in glass blowing. Ventilating apparatus of an approved design has just been installed, and everything is being done to make the help as comfortable as possible during the hot weather.

A part of the third floor has been converted into a pump room containing over 250 mercury air pumps. In the old pump room, which has been re-arranged, there are 500 more of these pumps, making a total of over 750. Each pump has been equipped with a very ingenious valve, the invention of Mr. A. L. Reinmann, the efficient superintendent of the factory. With all his multifarious duties, Mr. Reinmann has an alert eye to observe opportunities for improvements.

Seven Westinghouse high speed compound engines, of 200 horse-power each, are placed in the basement, from which power is distributed through the building. A number of motors are also used where small units of power are desired.

A large and well equipped laboratory is being put into shape for experimental purposes as rapidly as circumstances will allow.

The new boiler house is entirely completed. Babcock & Wilcox and National water tube boilers give an aggregate of 1,500 horse-power.

The Sawyer-Man Company is capable of turning out 15,000 finished incandescent lamps per day, and with their experienced help and 3,000,000 lamp bulbs in stock, any order for lamps will receive the prompt and careful attention which is characteristic of this company.

The Postal Telegraph Company has extended its lines to Denver, where an office was opened last week. The Postal will give that city additional facilities which have been needed for some time, and it is very probable that the rate will be reduced in the near future. The Postal is preparing to build a second route to San Francisco *via* Salt Lake and Ogden, and another to New Orleans, which will tap all important points in Texas.

Troy, N. Y.—Troy Electric Street Railroad Company; capital, $30,000.

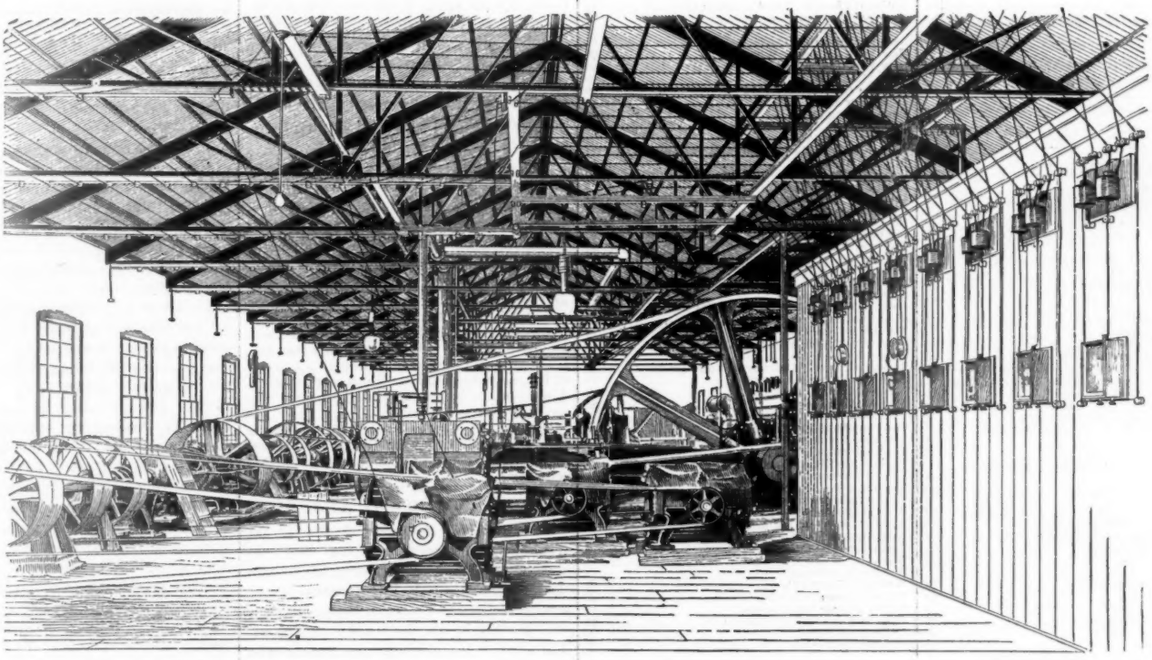
Eaton, O.—The Eaton Electric Light and Power Company; capital, $20,000.

Salem, O.—The Salem Electric Light and Power Company; capital, $50,000.

Greensboro, Ala.—The Greensboro Electric Light Company; capital $5,000.

Chicago, Ill—Brown Electric Company; to deal in patents and patented appliances; capital stock, $1,000,000; incorporators, F. H. Brown, I. L. Moore and others.

West Chester, Pa.—West Chester Electric Street Railway Company; capital $30,000. The officers are: President, Marshall H. Matlack; directors, William Hemphill, P. E. Jeffries, R. T. Cornwell and H. C. Baldwin.



Interior View of Waterbury Electric Light Station, Showing Roof Constructed by the Berlin Iron Bridge Company, East Berlin, Conn.

Ashtabula, O.—The Ashtabula Street Railway and Electric Company; capital, $50,000.

Indianapolis, Ind.—The Indianapolis and Broad Ripple Rapid Transit Company; capital, $100,000; Joseph Ferguson, president, and Dr. R. C. Light, secretary.

Tacoma, Wash.—Pacific Messenger Company, to operate a district telegraph system; capital, $30,000; incorporators, John M. Bell, N. J. Levison and F. A. Chrisman.

Abilene, Kan.—The Mosher Arc Lamp Company; capital, $50,000; directors, J. A. Mosher, S. C. Mosher, W. S. Hodge and Theodore Mosher, of Abilene, and H. E. Rogers, of Hampden, Ohio.

Leavenworth, Kan.—The Citizens' Electric Railway Company; capital stock, $300,000; directors, W. D. Kelly, J. W. Folger, L. Hawn, W. N. Todd, W. B. Nickels, E. A. Kelly, Otto H. Wulfekuhler.

Philadelphia, Pa.—The Kennedy-Groswith Electric Company, with a capital stock of $1,000,000. This plant is to be located in Philadelphia, where all kinds of electrical goods will be made. Charles W. Kennedy and Henry Groswith, of Philadelphia, own the greater portion of the stock.

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It turns out that the alleged telegraphic transmission of images by Professors Hughes and Preece, really was intended for a joke upon their scientific friends. This is very undignified employment for such gentlemen. It is more than likely such transmission will be an accomplished fact some day, as the problem does not in the least involve impossible equations. In view of this, it is not particularly funny to see a pair of distinguished scientists lead the public to believe the problem is solved, and organize a looking-glass arrangement, which a school boy might find easy work, to perpetrate the deception.

Since January 1, 1890, the ELECTRICAL REVIEW has chronicled the formation of 482 new companies which have been incorporated to do business in the electrical field in this country. This list includes the following branches of the industry: Electric lighting, electric power, electric traction, telephony, telegraphy and the many subdivisions of the electrical supply business. The average capitalization of 100 companies selected from the list at random is over $150,000. Multiplying this by 482, we get $72,300,000 of capital authorized for investment in the electrical industry in a little over seven months. Was there ever in the world's history a parallel to such rapid growth?

Only the brush of Doré and the pen of Danté could do justice to that awful scene at Auburn. The excited executioner forcing the switch again and again across the contacts, the dynamo leaping from the floor, moaning as if a thing of life in mortal pain, and convicts in stripes clinging to the slipping belt; in the adjoining room, a patient victim, strapped to a chair and smothered beneath a leathern mask, giving forth blood-curdling cries and groans from between foam-flecked lips, while huddled near, with pale, drawn faces, were the awe-stricken witnesses, some fainting, others staggering, groping to the door to fall outside; and then, to increase the horror, the close and sultry room is filled with the terrible stench of burning flesh and hair, as the fantastically curling smoke ascends from the roasting body of the tortured criminal. Oh, Gerry! in the name of Mercy you did this! And if it goes down to history as *Gerrycide*, you will have deserved it—and your only excuse can be that you knew not what you did.

We have received from Mr. Allen R. Foote, special agent of the eleventh census, a copy of the census schedule for central electric lighting and power stations. The schedule will be transmitted to the central station companies during the next three or four weeks. It is extremely desirable that it be correctly filled out and promptly returned to the Census Office.

The questions are pertinent and not too numerous, and the authorities will hold the answers strictly confidential. No publication will be made in the census reports which will disclose the names or the operations of individual establishments.

Officers of central station companies will find in this schedule many features of value and usefulness to them and the public. Each company, by doing its own part thoroughly and well, will help to make this census report on the electrical industry a work of lasting value, and a milestone to mark a decade of such progress as the world has never before witnessed.

On behalf of Mr. Foote, we bespeak a careful compliance with the reasonable requests of the Census Office contained in this schedule.

THE CREMATION AT AUBURN.

The horrible, sickening details of the Kemmler execution demonstrate very conclusively that a current of electricity is not the unerring death-dealing instrument the sentimentalists and alleged humanitarians who invoked its use claimed it would prove. The world is full of cranks and fanatics who have a consuming desire to revolutionize something; they yearn for a *hobby* to ride. A maudlin sympathy for red-handed murderers led a few such misguided enthusiasts to secure the abolition of hanging as a mode of execution and the substitution of something which they believed would make death seem like "wrapping the drapery of his couch about him and lying down to pleasant dreams." Conceding that society has a moral right to extinguish the spark of life and that this right is founded upon the deterrent effect produced on other criminals, the effort to make the transit to the other state as easy and comfortable as possible for the victim rather weakens the force of the lesson. It is argued with much force by another class of people, that all punishment should be reformatory in its tendency, and that killing should be abolished. But the general public in this country is not persuaded that the old idea of a life for a life is not a good precept. Capital punishment, so long as public sentiment remains in its present phase, must continue. The hangman's way of doing the work has been found efficient; can it be said the torturing method exemplified on Kemmler is so? As described elsewhere in this journal, the scene was sickening. The current had to be applied twice before it killed the victim, and after the first application, when 1,700 volts coursed for 17 seconds through the murderer's body, spasmodic upheavals of the chest, flow of blood from abrasions, fluttering breathing and frothy exudations at the mouth, indicated clearly that the vital spark was not extinct. It was not until after a second and longer application of the current, during which the man was actually roasted by the great heat developed at the electrodes, and nauseating vapors of burning human flesh spread through the room, that the work was complete. It was a scene which made several strong men faint. The immortal Danté would have been delighted to picture it in *The Inferno*. And yet this was the much vaunted *scientific* execution.

The result might have been anticipated. It could not be expected that inexperienced men could safely handle an electric current; it is frisky enough to require all the attention of those skilled in handling it. Nor could it be expected that any human being should know how much current would be required to kill. Every individual has a strong "personal equation" which can never be found out until he is killed. A voltage sufficient to kill one man may be endured easily by another. Why should this playing with electricity be tolerated? Why, in view of this uncertainty, should the mysterious agent, whose magic powers are revolutionizing the industrial arts and increasing the comfort of mankind, be prostituted to an employment which debases it to the plane of the hangman's knot? Its secrets are shared only with those who are associated with it during a long and close intimacy, and they are men who cannot be paid to steep their hands in their fellows' blood.

The men who must perform the office of executioner must be such as will necessarily bungle work which requires scientific management, and such fiascos as the one at Auburn must often occur; indeed, we should not have been surprised if some of the attendants had been killed and the murderer had escaped unhurt.

The result points conclusively to one end; the law must be repealed. It was sheer nonsense to pass it; it was not needed; hanging was good enough, the traditional horror of the hangman's noose being as repulsive to the average mind as any fear that could be inspired by any other mode of punishment. Electrical execution is an utter failure; in lieu of being humane it was the most horrible execution in the whole century, outdistancing the screws of the Inquisition. It needed only to become monumental as a scene of cruelty for Kemmler to have given some manifestation that he realized his situation between shocks; and but for the hurried second blow when he gave unmistakable signs of life, it is likely he would have made frantic efforts to escape the roasting spit on which he was impaled. In lieu of being private and its details withheld from the public, every disgusting feature was bruited abroad the instant the task was accomplished.

Something should be done to postpone the execution of those under death sentence until the law authorizing electricity as the death-dealing instrument shall have been repealed. The civilized world would be outraged to learn that the ghastly experiment, which is the quintessence of cruelty, was to be repeated and the fair escutcheon of the Empire State sunk still deeper in the sable shadow of disgrace.

The Twelfth Convention of the National Electric Light Association will be held at Cape May, commencing next Tuesday, August 19.

As far as scientific results are concerned, the horrible experiment at Auburn was a most profound failure. We have practically nothing new upon which to base any theories as to the effects of a current of electricity upon the human body. In the first place, no one knows exactly what the voltage was; it fluctuated, so the witnesses say, from 700 to 1,800 volts. Nothing whatever has been said about the quantity of current used. No one seems to know exactly how the bank of lamps was connected up. We are as much in the dark as we were before this poor wretch was roasted to death.

CORRESPONDENCE.

WHAT THE "REVIEW" HAS TO REPORT FROM ITS DIFFERENT HEADQUARTERS.

OUR ATLANTA LETTER.

All the Electrical Companies here are doing well; their business is good, and prospects for the future promise favorably. The public appreciates the many uses to which electricity is being applied, and is ready to adopt it as soon as demonstrated a success.

The Telephone Business here is good. The company has over 1,000 subscribers, and is adding new subscribers every day. Several outside lines have been constructed. There is a line to Marietta, 20 miles; East Point, 6 miles; Palmetto, 26 miles; Fairburn, 20 miles; Newman, 40 miles; Decatur, 6 miles; and lines are building to St. Mountain and Lithonia, 26 miles. The service is as satisfactory as could be expected. The management is composed of active young men, well suited for the various positions to which they are assigned. Mr. Gentry, manager, Mr. Jackson, assistant manager, and Mr. Bailey, chief inspector, are an excellent team at the head of the business. With these gentlemen at work making friends where they go, getting orders and looking after the many details of the business as they do, the company could not make a better selection, and we predict a good future for the young men, as well as the company.

The Electric Light Business has been pushed to an unexpected point of success through the Thomson-Houston Electric Company, by their able southern agent Judge Palmer. He is one of the best men they could have selected, and his worth to them and energy in the business has been fully demonstrated by his work.

The Georgia Electric Light Company that furnished the city has reason to feel grateful for the success they have made, and it has been largely due to the careful management of their superintendent, Mr. Geo. H. Wade. He is young, active and attentive to the duties, and the city as well as the company are proud of the electric light plant.

The Electric Street Railroad Companies are doing a splendid business in the hands of such men as Mr. Joel Hunt and Mr. L. D. Nelson, backed by some of the best and wealthiest business men of the city. The Edgewood line, constructed and owned by the East Atlanta Land Company, of which Mr. Hunt is the general manager, have, it is said, one of the best constructed electric street railroad lines in the country. Their only aim was to get the best, and they have evidently succeeded. Their line is about 1¾ miles long and extends from center of city out through Inman Park, one of the most pleasant resorts and most desirable residence portions of Atlanta.

The Fulton County Street Railroad Company have several lines in the city, or, in other words, so constructed as to make a circuit that is unequaled for travel, and they also have a nine-mile circuit which takes in several miles of the country. These lines are under the management of Mr. L. D. Nelson and are proving a success as a means of travel much superior in every respect over the old style of horse car and dummy. If left to the wishes of the people, it would not be long before all other street car lines, using horses and dummies, would be converted into electric railways.

The Electrical Business in general is good all over the South. There are several electrical supply companies in the city and they are all well patronized. H. H. J.

Atlanta, Ga., July 30, 1890.

OUR ST. LOUIS LETTER.

A Report was Circulated recently that St. Louis intended to have the names of its streets painted on the globes of the electric light lamps, so that a shadow five feet long might be thrown on the paving below. This is, no doubt, a novel method of designating the streets, but hardly practicable. Even with a slight breeze the lamps sway to and fro, and are constantly turning. An order for 400 more lamps has again been given.

The St. Louis Exposition people are now actively engaged in fitting up the exhibits for the coming season. Mr. Fred H. Whipple is again director of the electrical exhibit and he expects to eclipse all former displays in that department.

The Vandalia (Pennsylvania) Railroad has just equipped ten of its locomotives with electric headlights and eight more will soon carry the same light.

The St. Louis Suburban Railway Company intends to build an electric line from its present western terminus to Forest Park. This road is the successor to the old Cable & Western Company, having recently bought in that property.

The Union Depot Line has decidedly improved since my last letter, and it is evident that there is no fault in the system. Since additional horse-power has been put in the power house, the line has been working very smoothly, indeed. When the plant was first built, it was intended to run only a trial branch then being built, but afterwards the whole line was changed and extended, but with little change in the plant. At present, the road is in perfect running order. Two more Thomson-Houston motors have been ordered.

The Short System on the Seventh street line is running well.

The Southern Railway is changing its motive force to electricity. Its equipment will consist of 26 Thomson-Houston motors, six 130 horse-power generators, and eight 125 horse-power Ball engines. Stephenson has the contract for the motor cars. The line will be running by September 15.

The Gold King Mining Company, of this city, have arranged to have an electrical equipment placed out at the mine. Their agent is now East, selecting the necessary machinery.

Suburban.—Joplin, Mo.: The Joplin Electric Railway & Motor Company, with a capital of $100,000, was incorporated. They will use the Thomson-Houston system. The Thomson-Houston Company, it is reported, is about to build an immense plant at the mines of this city. All the mines will be lighted by electric light, and all machinery will be run by electricity. Sedalia, Mo.: The Sedalia Electric Railway, Light and Power Company has increased its capital stock to 200,000. Cairo, Ill.: A franchise to construct and operate an electric railway over five miles of street has been granted the Cairo Electric Street Railway. The old line will also change to electricity. Slater, Mo.: An election held for the purpose of voting bonds to the amount of $7,750 to buy an electric plant, was carried. Moberly, Mo.: The Western Engineering Company is going to build an electric road on all the available streets of this city. W. H. B.

St. Louis, Aug. 5, 1890.

OUR TACOMA LETTER.

An Electric Railroad is to be built between this city and Puyallup, about 10 miles. The cars have already been ordered.

The Centralia Electric Lighting Company will extend its wires to Chehalis and light that place. Four new dynamos will be required.

The Bellingham Bay Electric Street Railway Company has been incorporated, with a capital of $200,000.

The Olympia Light and Power Company are actively at work on the dam at Tumwater and some heavy blasts are being made. The dam rests on solid rock and will be completed in a month. It is 120 feet across and 30 feet high. It will be constructed of timber cribbing, filled with stones and covered with concrete. The upper side will be double sheeted with heavy planking, making it impervious to water. There will be a fall of 30 feet, giving from 400 to 600 horse-power. The dam will cost about $3,000.

The Tacoma Street Railway will put in several miles of extensions. Three new dynamos, which will give 700 horse-power, have been ordered from Schenectady, N. Y., and the power house will be much enlarged. Twenty-four new combination cars, partly opened and partly closed, have been ordered. They are 28 feet 3 inches long, equipped with air-brakes, a new invention, and three electric motors of 15 horse-power. The cost of these cars, exclusive of the motors, will be $2,200 each, and they will be the finest and best so far built in the United States. New rails, weighing 45 pounds to the yard, are being laid on all the tracks. The amount to be expended in the improvement of the plant, including a cable up one steep grade, is $350,000. H. L.

Tacoma, Wash., Aug. 1, 1890.

OUR BOSTON LETTER.

Kendall & Slade have received the contract for the outside construction work for the Lynn and Boston Electric Railroad Co., and have a large force at work building a line that will extend from the West Lynn stables to Wyoma, about eight miles. Single and double track will be laid. The system will be the overhead single trolley, and the latest pattern Thomson-Houston apparatus will be used.

Herbert E. Goodman, secretary and manager of the Sperry Electric Mining Machine Company, of Chicago, favored this office with a pleasant call last Friday.

Mr. L. H. Rogers, the New England representative of the Brush Electric Company, has taken the contract for installing a complete Brush alternating plant in Woodsville, N. H. The city fathers were much pleased with the Brush plant at Bristol, N. H., which is in the front rank of alternating plants, and decision was rendered accordingly.

A Manhole cover was blown off the Edison conduits at Washington street and Hayward Place, on Friday afternoon. No one was injured, but the insulation on the wires in the conduit was burned off.

The New England Telephone Company is improving its service between Boston and Lowell and Boston and Worcester, by constructing two new lines between Boston and each of those cities.

New Corporation.—Cohasset Electric Light Company, of Cohasset; capital, $30,000, in shares of $100 each. A. G. Lawrence, president.

The Knowles Loom Works, of Worcester, Mass., will be lighted shortly by 800 incandescent lamps, on the Mather system, from an isolated plant.

The Edison Illuminating Company has finished the laying of conduits in this city, and is now busily at work removing its overhead wires. This is being done at the rate of 20 services a day. The work will be finished about the middle of August.

The Walworth Manufacturing Company, of this city, which has leased a portion of the Continental Tube Works in Pittsburgh, Pa., to manufacture electric street railway, telephone and telegraph poles, etc., has started the plant in full, and is now shipping from 50 to 60 tons of poles a day, with orders ahead for some time.

New Engine and Motor Company.—A corporation to be known as Van Depoele International Company, with a capital stock of $100,000, $300 paid in, has been organized at Portland, Me., for the purpose of manufacturing reciprocating engines and motors. The officers are: President, George W. Davenport, of Boston, Mass.; treasurer, Demaso Mazend, of Boston, Mass.

Narragansett Electric Light Company.—A Boston electrician, on a recent trip South, visited the station of the Narragansett Electric Light Company, Providence, R. I., where he observed the most thorough method of testing incandescent lamps he ever saw. A number of electric light companies test their lamps after a fashion, but, as a rule, the investigation is not a thorough one. The Narragansett Company, on the contrary, tests every invoice of lamps received of all makes. This is done by the use of a photometer, voltmeter and a dynamometer. The first ascertains the candle power, the second the volts used, and the third the amount of current consumed. By these readings it can be ascertained whether an incandescent lamp will require 5 or 2 watts to the candle power, the knowledge of which means a great saving to the consumer who pays for current by the meter.

Telephone News.—The Union Telegraph and Telephone Company has declared quarterly dividend, No. 7, of one per cent., payable August 18 to stock of August 8. The operations for the quarter ending June 30, 1890, were:

Gross earnings	$6,215.54
Gross expenses	5,106.74
Balance	$1,108.80
Dividend No. 7	1,000.00
Surplus	$108.80
Surplus to March 31, 1890	1,149.37
Total surplus to date	$1,258.17
Number of subscribers, 508.	

The Erie Telegraph and Telephone Company has declared dividend No. 27, quarterly, of one per cent., payable Aug. 18, upon stock of Aug. 8. The Cleveland Telephone Company, the Northwestern Telephone Exchange Company and the Southwestern Telegraph and Telephone Company, report for the three months ending June 30, 1890:

Gross income	$189,391.93
Gross expenses (including dividends payable to stock of Aug. 8)	179,548.70
Balance	$9,843 23
Subscribers connected March 31	12,245
Added during the quarter	417
Total June 30, 1890	$12,662
Proportion of dividends received by the Erie Company	51,600.58
Dividend No. 27	48,000.00
Surplus	$3,600.58

The New England Wiring and Construction Company is rushed with business just now, having many large contracts in hand. Among others may be mentioned the new Chamber of Commerce in this city, which is being wired for over 1,000 lights. The same building will also be tubed and wired for bells and annunciators. They are also wiring the Bradley Building, Tremont street, for 250 lights. The Temple Club house has just been wired throughout, so has Dr. Bergergreen's house at Lynn, and the Mansion House, South Framingham. A contract has also been booked from the Thomson-Houston Electric Company, for the installation of 1,000 lights in the Ponemah Mills, Taftsville, Conn. At Groveton, N. H., they are installing a plant of 600 lights capacity, and are doing many other large jobs. W. I. B.

Boston, Aug. 9.

The patents covering the Widdefield-Bowman automatic electric brake system for freight trains, were recently purchased by the Westinghouse Air Brake Company, of Pittsburgh. The system and a test of the same on the Lehigh Valley Railroad, were described in the ELECTRICAL REVIEW last year.

THE TESTIMONY OF AN EYE-WITNESS.

Mr. Chas. R. Huntley, chairman of the Executive Committee of the National Electric Light Association, and general manager of the Brush Electric Company, of Buffalo, N. Y., was invited to be present as one of the witnesses of the Kemmler execution. We publish an extract from a private letter from him to the Editor of this journal, in which he describes the execution, and while not written for publication, we are sure Mr. Huntley's intelligent views will interest all the electrical fraternity where he is widely known:

IGNORANCE IN CHARGE.

"I went down to Auburn more especially that I might see how the electrical part of the affair was conducted. So far as I was able to see, everything was wired up all right, but I question very much whether any one had any particular ability in the handling of the electrical apparatus to be used for such a purpose. There were loop-holes that could occur to admit of grounds and open circuits at a critical period.

A HORRIBLE SIGHT.

"All that you have seen in the papers regarding the horrible sights does not half picture what it was to one who, like myself, was not used to seeing a being tortured. As you know, the doctors pronounced him dead. Afterwards they started up the apparatus and fairly roasted the man. Whether he had feeling or not is an open question. I assume that he did not, as reputable physicians like Shrady say so, but that he was alive is beyond a doubt.

NO ELECTRICAL DATA.

"I cannot give you any electrical data as to the current that was used, and I do not think that the man, Davis, who was in charge, knew himself. I presume that he did the best that he could. The two machines were old and had no special care. They had not been tested except in the afternoon and I witnessed that. Whether there were grounds on the machine or not, no one knew. No speed of the dynamo was ever taken, or of the shaft, and no records kept of the electrical output.

THE GROANING AND LEAPING DYNAMO.

"Mr. Barnes, of Rochester, was in the dynamo room when Kemmler was killed and he tells me that during the second application the dynamo was run at such a speed that it fairly leaped off the floor. The belt was slipping, it being a new one, and as they short circuited Kemmler across the terminals the machine would groan as alternating dynamos do when there is a line down or a short circuit occurs.

KEMMLER'S AWFUL CRIES.

"I have seen all the electrocutions or executions that I want to see. If I could have gotten out of that room while that man was making that awful noise, I would have given a year's salary to have done so. Our District Attorney was the only wise man there, as he left the room and fainted outside.

"Davis had two other men not at all connected with electrical matters. One was the yard master of the prison and the other was an attache of Comptroller Wemple's office at Albany. Who threw in the switch is not definitely known.

A TRUE ACCOUNT.

"I do not tell you of the movements of Kemmler, as you have already had that through the papers, and substantially every thing that was said by the associated press reporter is true and is an exact account of what occurred."

A Compliment to Mr. Read.—Also to the "Review."

[From the *Court Journal.*]

The well-known Washington patent attorney, Mr. Robert H. Read, has recently accepted the management of the Patent Bureau of the New York ELECTRICAL REVIEW.

This department of the paper is a very important one, and will doubtless be largely extended, now that a man so experienced and competent as Mr. Read has charge of it. The REVIEW is the best electrical paper we know of.

The Twelfth Convention of the National Electric Light Association.

Mr. Allen R. Foote, secretary and treasurer of the National Electric Light Association, has just had published a bright and tasty little souvenir of the Cape May Convention. It gives all the desirable information about getting there, what will be done, and so on.

This convention is expected to be a memorable one in the annals of the National Electric Light Association, and he who misses it will be a victim of acute regret.

Over 150 persons have already engaged rooms at the Stockton Hotel for the "electrical season," which lasts from Saturday, August 16th, until Monday morning, August 25th.

On Saturday, the 16th, a party will leave New York City for Cape May in special Pullman cars. The train leaves at 1:50 P.M., from the foot of Cortlandt street, and the party will be under the care of Mr. John A. Seely, of the entertainment committee. This party will be composed of a number of electrical men, their wives and families.

Telephonic News

⁂ The long distance telephone system connecting New York and Washington is now in successful operation.

⁂ The return wire for the Lookout Mountain division of the telephone service has been stretched from the central office in Chattanooga to the top of the mountain, and four of the eleven telephones on the mountain have been attached to it.

⁂ The Southern New England Telephone Company has obtained a temporary injunction restraining the North American Construction Company, of Pittsburgh, from erecting the plant of the Windsor Locks, Connecticut, Electric Light Company. The object of the telephone company is to prevent trouble from induced currents which might be caused by the proximity of the electric light wires to the telephone wires. The case will be argued in New Haven, early in September.

⁂ At a meeting of the directors of the Tropical American Telephone Company, recently, it was voted to pay a dividend of one per cent., or ten cents per share, on the 15th day of August to stockholders of record Aug. 1st, and a further dividend of ten cents per share on the 1st day of October to stock of record Sept. 15th, and that in future the dividend days will be April 1st and October 1st. The general manager's report showed a gain of nearly 100 per cent. over the preceding year, and the treasurer's report showed $24,000 cash and $25,000 bills receivable in excess of debts. Mr. Harry Highly was elected secretary and treasurer.

⁂ The development of telephony in this country is now so steady that it does not attract attention, says the *Telephone News Letter*. According to the statement of the American Bell Telephone Company for the month ending June 20th, there are now 466,334 telephones in use in the various exchanges and on private lines, as compared with 430,476 at the same period last year. This shows a gain for the year of 35,858 instruments, or about 3,000 per month. These figures do not represent, however, the whole growth of the telephone business, as there is going on at the same time a rapid development of what is known as the extra-territorial system and of the long-distance system. The extra-territorial system links together the places a few miles apart in the same territory; the long-distance system unites cities hundreds of miles distant from each other. There is now a large amount of telephonic work between Boston, New York, Baltimore, Washington, Philadelphia, Albany, Buffalo, New Haven, and other cities, while Chicago is again the center of another field of activity in long-distance service.

An Electrical Exhibition at Spokane Falls.

A combined movement on the part of Washington, Oregon, Idaho and Montana, has resulted in the determination to hold an electrical exhibition in Spokane Falls, Wash., beginning October 1 and lasting a month. It is proposed to have it the largest and best exhibition ever held West of the Rocky Mountains. The buildings will not only be illuminated by arc and incandescent lights, but the entire machinery, including over 800 feet of shafting, will be run exclusively by an electric current, generated by water power over a mile from the building.

The railroad companies have granted free return of all the exhibits, and it is probable that arrangements can be made for free transportation of the exhibits from the East.

The Spokane Falls Electrical Society has kindly offered to take charge of all exhibits sent to their care, without any expense to the exhibitor. They will have several competent men constantly in charge of the exhibits.

It is a grand opportunity for electrical manufacturers to introduce their goods into the most rapidly growing section of the country.

THE WORKING EFFICIENCY OF SECONDARY CELLS.

BY W. E. AYRTON; C. G. LAMB, E. W. SMITH AND M. W. WOODS, ASSOCIATES.—READ AT MEETING OF INSTITUTE OF ELECTRICAL ENGINEERS, EDINBURGH, JULY 16TH, 1890.

(Concluded from last issue.)

VIII.—CHEMICAL ACTION.

Dr. Frankland has shown that probably the discharge of an ordinary accumulator is accompanied by the formation of one or other, or both, of the new lead salts which he has isolated, and which have the formulæ ($Pb_2S_2O_{10}$) and ($Pb_5S_2O_{14}$), respectively. And he concludes that, in view of the great difficulty of electrolytically splitting up the well-known white sulphate of lead ($PbSO_4$), this sulphate is not formed in the ordinary discharge of the accumulator, and is only produced when the cell begins to "sulphate."*

Professor W. Kohlrausch and C. Heim show in their paper, already referred to, that the observed variations in the specific gravity of the liquid during charge and discharge agree well with the very simple chemical actions:

Charge.

Positive plate
$$PbSO_4 + 2\,H_2O + SO_4 = PbO_2 + 2\,H_2SO_4.$$
Negative plate
$$PbSO_4 + H_2 = Pb + H_2SO_4$$

Discharge.

Positive plate
$$PbO_2 + H_2SO_4 + H_2 = PbSO_4 + 2\,H_2O.$$
Negative plate
$$Pb + SO_4 = PbSO_4.$$

It is to be noticed, however, that the falling off in the specific gravity during discharge is merely a test of the amount of H_2SO_4 that is converted into H_2O, and affords no criterion as to what sulphate of lead is formed by the SO_3 liberated.

During our investigation we observed the variation in the specific gravity of the liquid during about 100 charges and discharges, and the mean of this large number of the fairly consistent results that we obtained showed that, with the accumulators we were testing, the variation in density per ampere hour was about 0.000232. This result is probably right to within five per cent., for our hydrometer would read accurately to about 0.001, which is about five per cent. of 0.03, the total change in specific gravity observed during the discharge; and, therefore, as each result is correct to something like five per cent., the mean of a hundred results will certainly be correct to within five per cent.

On referring to tables of the density of dilute sulphuric acid, we find, by plotting the results, that between the limits we are concerned with—1.2 and 1.17—the change of density is directly proportional to the amount of SO_3 taken from the solution; and, further, that to produce a change in density of 0.01 at 15° C., it requires that one gramme of dilute sulphuric acid of density 1.2 should give up 0.01268 of a gramme of SO_3. And as the liquid in each cell weighed about 10,490 grammes when the cell was charged and the density 1.2, it follows that the weight of SO_3 liberated per ampere hour in each cell, when calculated from the variation in the specific gravity, must equal

$$\frac{0.000232}{0.01} \times 0.01268 \times 10{,}490 \text{ grammes,}$$

or 3.086 grammes.

Further, the electro-chemical equivalent of SO_3 is 0.000414 grammes per coulomb; and since lead sulphate is formed on both the positive and negative plates during the discharge, the weight of SO_3 taken out of the liquid per ampere hour, when calculated from the electro-chemical equivalent of SO_3, must be

$$2 \times 3{,}600 \times 0.000414 = 3.041 \text{ grammes.}$$

These two results show a close agreement. At the same time it is to be noticed that not merely does the amount of SO_3 liberated per ampere hour come out somewhat higher when calculated from the *mean* change in the specific gravity than when calculated from the chemical equivalent, but the same result is obtained for each separate set of tests.

Mr. G. H. Robertson, working in Dr. Armstrong's laboratory, was so good as to analyze the sediment that fell to the bottom of the cells during the early part of the investigation, when in the discharge the P.D. was allowed to fall to 1.6 volts per cell.

The mixture was found to contain:

An indication of uncombined metallic lead,
A trace of antimony,

40.95 per cent. of combined lead		} *i. e.*, 47.3 per cent. of PbO_2.	
6.35 " "	oxygen		
34.63 " "	lead	} *i. e.*, 50.74 per ct. of $PbSO_4$.	
5.86 " "	sulphur		
10.75 " "	oxygen		
		98.04	

so that 1.96 per cent. consisted of metallic lead, antimony and dirt.

The composition of the sediment showed a close approximation to PbO_2, $PbSO_4$, which consists of

44.08 per cent. of PbO_2
55.92 " $PbSO_4$

PbO_2, $PbSO_4$, in fact, contains

76.33 per cent of Pb
5.91 " S
17.76 " O

and the sediment contained

75.58 per cent. of Pb
5.37 " S
18.05 " O

Dr. Frankland's salts may be represented as PbO_2, $2(PbSO_4)$ and $2(PbO)\,3(PbSO_4)$, respectively, whereas the analysis of the deposit in our cells showed that it was certainly neither of these lead salts, but, instead, had almost the exact composition of PbO_2, $PbSO_4$.

In spite of accumulators with pasted plates having been in use now for nine years, the chemical action that takes place during the different stages of the charge and discharge has only been conjectured, and, odd as it seems, no decisive experiment appears to have been made to settle this much-debated question. Various analyses have been made by different chemists of salts of lead acted on in certain ways with sulphuric acid, but apparently not of actual accumulator plates in action. We are, therefore, now, with the assistance of Mr. Robertson, making a complete investigation of the chemical state of the plugs of both the positive and negative plates at all stages of the charge and discharge of an 1888 E. P.S. type of accumulator in good condition. As this investigation, however, involves the chemical analysis of a large number of specimens, it will take some time yet to complete.

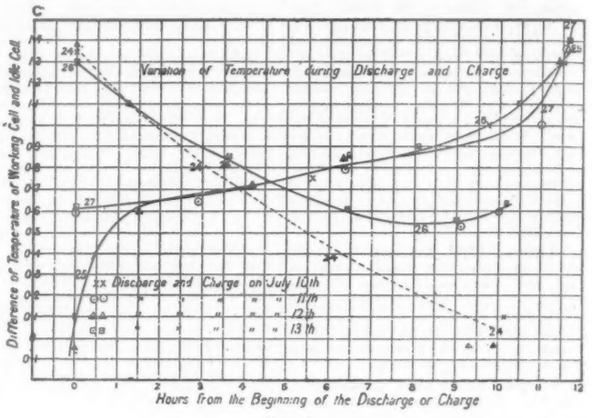

Variation of Temperature during Discharge and Charge
Difference of Temperature of Working Cell and Idle Cell
Hours from the Beginning of the Discharge or Charge
1x Discharge and Charge on July 10th
" " " " 11th
" " " " 12th
" " " " 13th

FIG. 8.

In order to observe what changes took place in the temperature of the cells during charge and discharge, the temperature of one of the cells under test was observed from time to time, as well as the temperature of the air and the temperature of an adjacent cell through which no current was being passed. The following temperature results, which were obtained during the steady discharges and charges after the first rest of ten days (Curves 10 and 11), are a sample of the observations taken. The discharge in each case commenced directly the P.D. in charging had reached 2.4 volts per cell, and the charge in each case commenced directly the P.D. in discharging had fallen to 1.8 volts per cell.

From the preceding table we see that while during the charge the cell rises in temperature, during discharge, on the contrary, it actually falls; hence, in spite of the production of heat due to resistance, the cell is actually cooler at the end of a discharge than at the beginning—a result possibly due to the splitting up of the sulphuric acid during the discharge. This cooling of accumulators during discharge, which we noticed early in our experiments, was also observed at about the same time by Professor Duncan and H. Wiegand, in America, and described in their joint investigation already referred to.

Date	Time.	Cell Under Test. State.	Cell Under Test. Temp.	Temperature of Air.	Temperature of Idle Cell.	Time from Beginning of Discharge or Charge.	Difference Between Temperature of Cell Under Test and Temperature of Idle Cell.	Rise or Fall of Temperature During a Complete Discharge or Charge, Compared with Temperature of Idle Cell.
1889. July	Hrs. Min.		Degrees C.	Degrees C.	Degrees C.	Hrs. Min.	Degrees C.	
10th.	1 10	Charged....	19.95	18.75	18.6	0 0	1.35	
"	11 20	Discharged.	18.6	18.6	18.5	10 10	0.1	−1.25 during discharge
"	16 55	Charging...	19.6	19.1	18.84	5 35	0.76	
"	21 6	"	19.9	19.0	18.9	9 46	1.0	+1.2 " charge
"	22 50	Charged....	20.2	18.8	18.9	11 30	1.3	
11th.	7 55	Discharging	18 65	18.25	18.1	9 5	0.55	
"	8 50	Discharged.	18.8	18.5	18.2	10 0	0.6	−0.70 " discharge
"	11 38	Charging...	19 05	18.6	18.4	2 48	0.65	
"	15 10	"	19.3	18.8	18.5	6 20	0.8	
"	19 50	"	19.7	19.0	18.7	11 0	1.0	+0.77 " charge
"	20 25	Charged....	20.1	19.0	18.73	11 35	1.37	
"	21 42	Discharging	19.95	18.95	18.85	1 22	1.10	
12th.	5 40	"	18.72	18.75	18.75	9 20	−0.08	−1.40 " discharge
"	6 20	Discharged.	18.72	18.75	18.75	9 55	−0.08	
"	7 50	Charging...	19.3	18.65	18.7	1 30	0.6	
"	10 30	"	19.5	19.0	18.78	4 10	0.72	
"	12 40	"	19.61	19.1	18.77	6 20	0.84	+1.33 " charge
"	17 45	Charged....	20.40	19.26	19.1	11 25	1.30	
"	21 30	Discharging	19.95	19.25	19.1	3 45	0.85	
13th.	0 22	"	19.7	19 1	19.1	6 37	0.6	−0.67 " discharge
"	2 55	"	19.73	19.3	19.16	9 10	0.57	
"	3 52	Discharged.	.....	.....	.....	10 7	....	
"	3 58	Just started charging..	19.78	19.08	19.15	0 8	0.63	
"	10 20	Charging...	20.0	19.2	19.15	6 28	0.85	+0.77 " charge
"	12 0	"	20.05	19.3	19.15	8 8	0.90	
"	14 20	"	20.30	19.25	19.2	10 28	1.1	
"	15 30	Charged....	20.6	19.4	19.2	11 38	1.4	

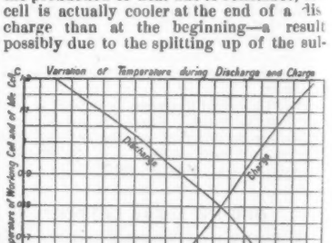

Variation of Temperature during Discharge and Charge
Difference of Temperature of Working Cell and of Idle Cell
Discharge
Charge
Time in Hours from Beginning of Discharge or Charge

FIG. 9.

From the last table we see that the rise of temperature of the cell during charging may, after allowing for changes of temperature of the room, be either about 1.3° C. or 0.77° C., while the fall of temperature during discharging may have either of the two preceding values. It is further interesting to notice that the rise of temperature during the charging has the higher or lower of these two values, according as the fall of temperature during the previous discharge had the higher or the lower value.

On plotting the differences between the temperatures of the working and the idle

* "Contributions to the Chemistry of Storage Cells," *Proc. Roy. Soc.*, vol. xlvi., 1889, p. 304.

cell, and the corresponding times given in the last table, we obtain the dotted line 24 (Fig. 8) for the time fall of temperature during the first and third charge. Curve 26 for the time fall of temperature during the second and fourth discharge, and Curve 27 for the time rise of temperature during the second and fourth charges; 24 is dotted, since temperature readings were only taken at the beginning and end of the first and third of these discharges. In the case of the second and fourth of the discharges here referred to, as well as in all the four charges, several observations of temperature were made. From the curves it appears that towards the end of the discharge and at the beginning of the charge, one or other of two things may happen—either the temperature in the discharge may go on falling, as in the dotted line 24, or it may begin to rise again, as in 26; whereas, in the charge, either the temperature at the beginning may rise considerably, as in Curve 25, or it may only increase slightly, as in Curve 27.

It would, therefore, appear that during the latter part of the discharge one or other of two chemical actions can take place; and these two actions have, for some reason or other, taken place alternately in the four discharges under consideration. But, curiously enough, these four discharges—which took place on July 10th, 11th and 12th, 1889—occurred with extreme regularity; so that when time curves were drawn, even on a large scale, for each of these discharges, they coincided exactly and produced a single curve, which is shown, greatly reduced, as Curve 10 on the sheet of curves given in the earlier part of the paper. And, similarly, for the four corresponding charges the four time curves all coincided exactly, producing a single curve, which is shown, greatly reduced, as Curve 11 on the same sheet. It, therefore, seems as if one or other of two chemical actions might take place during the latter portion of the discharge and during the earlier part of the charge, and yet, curiously enough, when the current is kept absolutely constant the time variation of the P.D. is exactly the same, no matter which of these two chemical actions takes place.

About a year later, another set of *continuous* temperature observations was made for many days and nights with the same cells, the current in discharging and charging being, as before, ten and nine amperes, respectively. The higher P.D. limit was, as before, 2.4 volts per cell, but the discharge was in each case in this second set of continuous discharges and charges stopped at 1.9 instead of 1.8 volts per cell. As the regulation of the current day and night was in these later experiments in 1890 effected by hand, it was not kept quite as constant as when the automatic regulator was employed. Hence the time curves for the excess temperature in discharging and charging, when plotted, were not found to be as regular as in the previous case. But they were quite regular enough to give the general shape of the sets of temperature curves for discharge and charge, which are shown in Fig. 9.

It will be observed that in these experiments not merely does the excess of the temperature of the working cell over that of the idle cell fall during the discharge, but it actually continues to fall at the commencement of the charge.

The times of discharging and charging are less than those given for Curves 10 and 11, partly because the P.D. was not allowed to run down lower than 1.9 volts per cell in the later observations, and partly because the times of discharging and charging had been diminished by the continued experimental rests to which these cells had been subjected in a charged state during 1889.

The mean temperature of one of our cells is during charging and discharging, roughly, 0.7° C. higher than that of the air; and experiment shows that if one of the cells experimented on be warmed up by a portion of the ordinary dilute sulphuric acid being replaced by warm sulphuric acid of the normal density, the cell will, after all parts of it have acquired a uniform temperature, fall in temperature by 0.2443° C. per hour. Of course, during such an experiment, no current is allowed to pass through the cell, nor should any current have passed for hours before the heat emissivity of a cell is determined, otherwise a wrong value of the emissivity may be obtained by local action in the cell generating or absorbing heat during the experiment.

Hence, if K be the heat capacity of the cell, $0.7 \times 0.2443 \times K \times 21\frac{1}{2}$ calories (gramme, centigrade) will be lost by radiation and convection during the $21\frac{1}{2}$ hours of charging and discharging. Now the weights and specific heats of the component parts of one of the cells under test are

	Weight in Grammes.	Specific Heat.
Dilute acid, sp. gr. 1.9..	10,490	0.792
Lead and lead oxide.....	12,987	0.0315
Glass.....	3.402	0.198

Hence, 0.2443 K equals 2,295 calories, and the loss of heat in charging and discharging equals 34,520 calories. The total watt hours given to a cell in charging was 228.2 (see Curve 11, for the *working* results obtained with the cells after the first rest of 10 days), therefore, the energy in calories given to the cell was $0.24 \times 228.2 \times 3,600$, or 197,200 calories. Hence, in consequence of the cell being slightly warmer than the air during charging and discharging, there is a

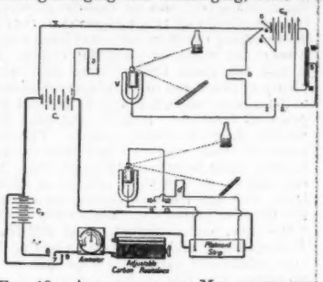


FIG. 10.—APPARATUS FOR MEASURING THE RESISTANCE OF THE ACCUMULATORS C_1.

loss of energy from radiation and convection equal to about 17 per cent. of the energy put into the cell, and this is more than sufficient to explain the total loss observed in the energy efficiency experiments, which amounts to only about 13 per cent. Indeed, it would almost seem as if a portion of this heat radiated must be supplied by an actual slow consumption of the material of the cell; so that, in addition to the reversible oxidation and de-oxidation of the material, which is the characteristic of the secondary cell, there was a certain amount of non-reversible oxidation, which is the characteristic of the primary cell.

The loss of energy in consequence of the current having to overcome the resistance of the cell is of far less importance than the loss of energy due to the actual continuous radiation and convection from the cell, which is slightly warmer than the air. For the mean resistance during discharging of one of the cells experimented on may be taken as 0.004 ohm (see Section IX., Resistance, Figs. 12 and 13), and the mean resistance in charging as 0.0045 ohm. Hence, during the normal 10 hours of discharge with 10 amperes there will be generated,

$$0.24 \times 10^2 \times 0.004 \times 10 \times 3,600, \text{ or } 3,456 \text{ calories,}$$

and during the normal $11\frac{1}{2}$ hours of charge with nine amperes,

$$0.24 \times 9^2 \times 0.0045 \times 11\frac{1}{2} \times 3,600, \text{ or } 3,621 \text{ calories.}$$

Only, therefore, 3,456 calories need be dissipated during the discharge of a cell, and 3,621 during the charge, in consequence of the heat produced by the current overcoming resistance; and to dissipate this amount of heat it would only be necessary that the mean temperature of the cell should exceed that of the air by about 0.14° C., or only about one-fifth of the actual mean excess. Whereas, what actually takes place is, that during discharge about 16,060 calories are dissipated by radiation and convection; and, further, the cell cools down, possibly in consequence of the splitting up of the sulphuric acid, and from 6,000 calories in some experiments to 12,000 in others, are thus absorbed. During the charge these 6,000 or 12,000 calories re-appear, warming up the cell, and, in addition, about 18,460 calories are dissipated by radiation and convection.

In order, then, to improve accumulators, what has to be especially sought for, and, if possible, then prevented, is that chemical action which keeps the mean temperature of the cell about 0.7° C. above that of the air. This chemical action is very possibly quite distinct from the reversible one which necessarily accompanies the storing up of the electric energy and its subsequent liberation.

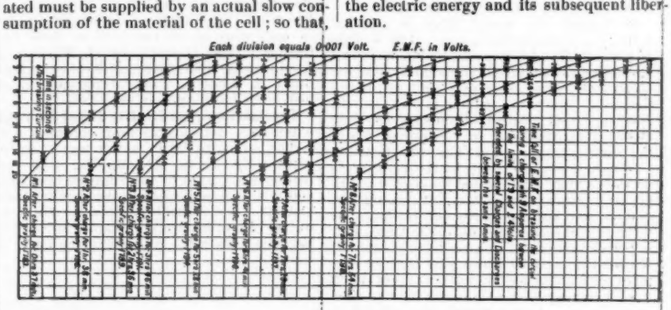


FIG. 11.

IX.—RESISTANCE.

The resistance in ohms of an accumulator when charging and discharging is given, respectively, by

$$\frac{V-E}{A}, \text{ and } \frac{E-V}{A},$$

where V is the P.D. in volts at the terminals when a current of A amperes is passing, and E is the E.M.F. of the accumulator at the moment V is measured. To measure E the main circuit is broken and the P.D. observed as quickly as possible. On breaking the circuit, however, the deflection of the voltmeter does not sharply change from the value that measured V to another definite value that measures E; but, on the contrary, as seen from Fig. 4, in consequence of the fall of the E.M.F. of an accumulator

(Continued on page 10.)

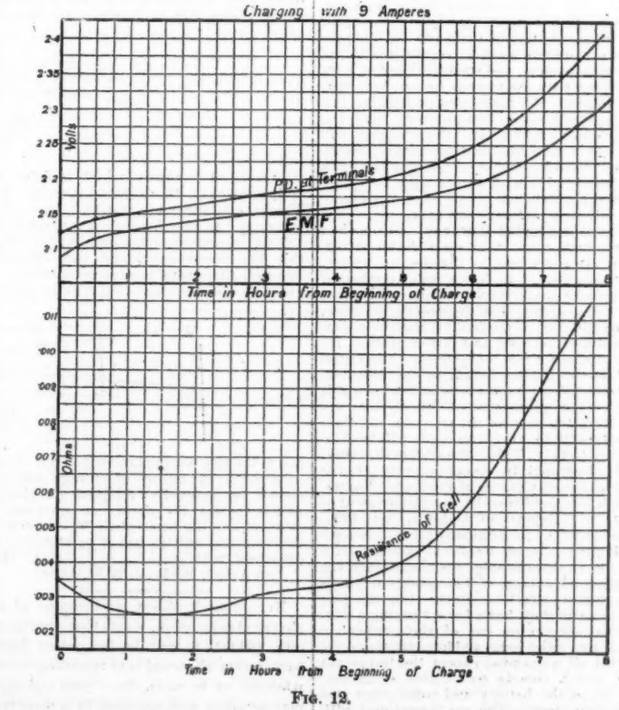


FIG. 12.

TELEGRAPHIC

General Eckert's Thanks.

The following circular has been issued to the heads of the departments of the Western Union Telegraph Company that were affected by the recent fire at No. 195 Broadway:

EXECUTIVE OFFICE
WESTERN UNION TELEGRAPH COMPANY,
New York, July 31, 1890.

It has been the source of much gratification to me and the subject of favorable comment by the members of the various committees of the company, that the recent destruction of the operating and adjacent departments by fire has exhibited in the most practical way the loyal zeal of our employés. To their untiring industry and efficient co-operation is due in the largest degree, the praises of the press and the public upon the skillful way in which the circuits and facilities were extricated from their apparent hopeless confusion. I have yet to hear of any expression other than that of the desire of every one to contribute his or her help in the almost marvelous re-establishment of the service which has been accomplished. In my long telegraphic experience, this calamity was the most serious that has befallen us, and I may add, to their honor, that the way in which it has been surmounted reflects the greatest credit upon the intelligence and unselfishness of all concerned. It has always been my contention that these qualities were distinguishing marks of the general body of telegraphers, and I take pride in the proof of my belief, even if its exhibition must be coupled with a disaster-bearing event.

The object of this note is, therefore, to request you to express to your subordinates the appreciation of the committees and executive officers for the assistance and service which they have so ungrudgingly rendered.

THOMAS T. ECKERT.
V. P. and General Manager.

The Advantages of the Printing Telegraph.

The printing telegraph, though a device of comparatively recent development, has been the subject of ceaseless investigation, and practical workers in electricity have directed their whole attention, in some instances, to the transmission of messages and the recording of them in plain Roman characters.

A very complimentary notice to a new system has recently appeared in various electrical papers as the most perfect and seemingly only practical system known. Its advantages are simply those of an electrical typewriter, by means of which the message is printed in the presence of the transmitting operator in page form and a duplicate of the same printed at all the receiving stations on the line, whether it be a long or short circuit.

The benefit of such an apparatus to the press at large can be readily seen, says our handsome contemporary, *Paper and Press*, especially for the distribution of current news in the various newspaper offices. A single transmission prints it simultaneously, in page form, ready for the compositor's case, in all the newspaper offices of many cities. In this particular phase it will be interesting to our readers to describe the system.

It is said by our contemporary to differ materially from every other known means of telegraphy in one essential particular. In it the impulses move the instruments, whereas, in other systems the instruments move the impulses—that is to say, the transmitter of the message is caused to run by a separate power. No combination of electrical impulses or currents is employed. An even succession of dots or impulses, which operate the polarized relay armature at the receiving station, places the revolving type-wheel in the required position, when the local mechanism causes the latter to be printed. The apparent impossibility of transmitting printed characters 500 or 1,000 miles over a single wire at once, presents itself to the mind and it is overcome in this system, it is asserted in a very simple way. Each letter of the alphabet is represented by a certain number of impulses which revolve the type-wheel to the required position when the letters are struck by the local mallet. Fourteen impulses represent the entire alphabet, making a complete revolution of the type-wheel, which may be turned 200 revolutions per minute, thus securing very rapid printing.

Its advantage, also, is that of absolute secrecy as a means of communication. The value of the printing telegraph for the transmission of news to newspaper offices is unquestionably a subject commanding attention on the part of progressive proprietors.

* * The Julien system of storage battery traction was recently put into successful operation on the Irvington street railway line at Indianapolis, Ind.

* * It is the expressed intention of the Galveston, Texas, City Street Railway Company to put in electric motive power. The Houston Street Railway Company will probably follow suit.

* * A feature of the international electrical exhibition in Frankfort will be the transmission of electric power. A firm in Lauffen, on the Neckar, will furnish currents of 500 horse-power over copper wires from a station 140 miles from the exhibition.

* * From the *Elektrotechnischer Anzeiger* we learn that the Allgemeine Elektricitäts Gesellschaft have announced their willingness, in conjunction with the Oerlikon Company, to transmit 300 horse-power from the Neckar, at Lauffen, to the Frankfort Exhibition, a distance of 175 km. (about 109 miles), on condition that an ordinary overhead cable, five mm. in diameter, connecting the two places, is provided free of cost.

* * The people of the village of Jamaica, L. I., who got temporary injunctions restraining the Brooklyn and Jamaica Road Company from running electric cars along the main street of their town, lost their suit against the company last week. Justice Cullen dissolved the injunction against the further use of electricity, and also against a double track. The use of electricity, he held, was technically in violation of the corporate rights of the company, but it had been employed as a motive power for two years without any objection from the villagers.

* * A West End official is reported as saying that the earnings of the West End Street Railway, of Boston, for July will be above $500,000, but hardly $550,000. As the road is now in a transition state, changing from horse-power to electricity, it is difficult to declare what operating expenses may be. Expenses are charged to operating account which will never appear there again. The July operating expenses will be probably fully 80 per cent., but will be reduced constantly under the extension of the electric system. The report for fiscal year ending September 30 will show a very handsome surplus above everything.

* * "Before the introduction of the motor as a propelling power," said a railway electrician to an Albany, N. Y., *Argus* reporter, "public sympathy wept over the poor car horse. Now, the people ought to sympathize with the poor motors. This hot weather plays the deuce with them. The atmosphere being so much heated, together with the friction, badly uses up several portions of the electrical horse and if care is not taken will ruin it. Some of the cars on the Watervliet road became so heated yesterday that they had to be laid off in order that they might cool. Laymen have no idea of the effect that a hot day will have on the electric motor."

* * In order that the motor cars of the Watervliet road may be run over its line in Troy, N. Y., without interruption when the draw of the Congress street bridge is open, it has been found necessary to stretch a big cable under the Hudson's waters, connecting West Troy and Troy. By this means the electric current continues unbroken when the draw is in operation, and traffic in Troy goes on without interruption. The submarine cable was laid two weeks ago, and no diver's services were needed to accomplish the work successfully. The time required was four and a half hours and six men did all the work. The cable is 2⅛ inches thick and is 430 feet in length. Its weight is 12 pounds to the foot.

MAYNARD TAKES IN TOLEDO.

A SEARCH FOR ELECTRICAL LITERATURE—ELECTRIC RAILWAYS GROWING IN POPULARITY.

This City Seems to be enjoying a quiet and comfortable season in the border land that lies between a hopeless tangle of overhead wires on one hand and the uncertainty of subways on the other hand. Whether this is owing to freedom from the influence of electrical journals may be a matter of question, but it required a three days' search with the assistance of a prominent electrical engineer to find a copy of one of them. It seems to be the impression among the profession that the ELECTRICAL REVIEW is the quarterly periodical edited by Mr. Lloyd Brice, and the other electrical papers have scarcely been heard of. No hostility to aerial wires has been manifested. The general satisfaction with the present state of affairs is evidently due in great measure to the good construction of the lines of the Western Union Telegraph Company and the Telephone Company. Both of these companies have some very excellent aerial cable lines leading out of their main offices, and their pole lines throughout the city show careful work. The lines of the two electric lighting companies are also in better condition than many which could be named.

In Street Car Lines there is decided activity and much enterprise. The Toledo Electric Railway Company, which has been operating the Thomson-Houston system for about a year, has been very successful, and the new company, which is the Toledo Electric Street Railway Company, has just closed a contract for an equipment under the same system. The Thomson-Houston Company's engineer, Mr. L. H. McIntire, is on the ground, surrounded by engine builders and other contractors, arranging the details and making plans for pushing the work to completion at the earliest moment. A permanent power station is to be erected within the next 90 days, and is to be supplied with about 900 engine horse-power and five 80 horse-power generators. A portion of the line is already wired, and cars are to commence running on it in a few days by power furnished from the station of the local lighting company, which is putting up an 80 horse-power generator for the purpose. This line is to be about seven miles long, half of which will be new road and the other half will run over the tracks of the Consolidated Company through the principal business streets. The trolley lines have already been erected along the latter portion of the route, and this move has led to a bitter legal fight. The new company has a franchise under which it claims the right to condemn the tracks of the old company for the purpose of running its cars over the line by the electrical system, and establish itself as joint occupant with the present owners and their horse cars. An injunction prohibiting this arrangement was at first granted; but it has just been dissolved, and the question will now go to the Ohio Supreme Court. Meanwhile the new company is pushing the work of construction with all the vigor that capital and the immense resources of the Thomson-Houston Company can give.

The Consolidated Company, with a clear determination to "keep up with the procession," is preparing to dismiss its horses. Without waiting to decide what method of propulsion shall be used, it has commenced the construction of a three-story building, 95 by 200 feet, at the foot of Monroe street, which can be used as a power station for any one, or for several systems. The initial test, in the United States, of the Mekarski compressed air motor is to be made on this road. The promoters of the system are building ten cars for the purpose, and their adaptability to American roads will be thoroughly tested. This is the system described and illustrated in recent reports of the United States Consuls at Paris and Nantes, which are published by the Department of State in "Reports of Consuls, No. 113." The officers of the company are also investigating the different electrical systems, with a view of determining for themselves the relative advantages of the various methods of operating street car lines. For the past six months they have been running a storage battery car on one of their suburban lines, two miles long, and have satisfactorily settled all questions, except the important one, which nobody seems able to answer, the life of the battery and consequent cost of maintenance. The car is equipped with a Daft motor and Gibson storage batteries, and has been making runs of 50 miles with one charging. Arrangements are being made for a trial of the Pumpelly battery on this road. G. C. M.

Toledo, O., July 30, 1890.

ANN ARBOR, MICH.

The University of Michigan has taken its place among the best institutions in the country for educating electrical engineers, and it has advantages which no other college possesses. The buildings occupied by the physical and engineering laboratories are new and are arranged in the most perfect manner for the purposes intended. The equipment of the department devoted to electricity, while not so extensive as those of one or two other institutions, is of the finest character, and is rapidly growing. One peculiarity of this University is that it does nothing for show and everything about it bears the stamp of every-day utility. It is just the place for a young man with plenty of pluck and not a plenty of money to get a good education and fit himself for practical business. It is not the place for wealthy dudes to absorb conceit. The full course is four years. Candidates for admission must be at least 16 years old. An entrance fee of $10 from citizens of Michigan, and $25 from all others, secures all privileges of permanent membership in the University, and an annual fee of $20 from Michiganders and $30 from others is the only additional expense, except $10 for a diploma. Candidates for a degree in the courses in engineering are examined in English language, algebra, geometry, trigonometry, history, natural philosophy, chemistry, etc. Students who do not wish to become candidates for a degree are allowed to pursue selected studies for shorter periods. The cost of living in Ann Arbor is about $5 per week. Henry S. Carhart, A.M., Professor of Physics, and Mr. George W. Patterson, Instructor in Electrical Engineering, are widely known as men who are at the head of their profession. The Department of Mechanical Engineering is in charge of Professor Mortimer E. Cooley, whose reputation as an instructor has long been established.

The Question of an Electric Street Railroad, which has, for several years agitated Ann Arbor, seems to be in a fair way of settlement. Mr. J. R. McLaughlin, who was formerly an agent of the Sprague Company and who is now located in the Moffat Block, Detroit, has a franchise for a road which requires him to have it completed by September 1, and the rails are now being laid. It is to be about three miles long, single track, and will afford communication between the University, the railroad station and the principal portions of the city. It will be built of 45 pound rails, with cross suspension, single trolley lines, without return wire. It will be equipped with four Brill motor cars (Sprague motors) and four trail cars. Power is to be furnished by the local electric light company, which is doing the city lighting with decided success. The Thomson-Houston arc system is used. The company has also heretofore operated the Edison incandescent system, but last night this was discontinued and the Thomson-Houston alternating system substituted. In granting the franchise to this railway company, the city authorities stipulated that if propulsion by means of storage batteries should be generally adopted as electric motive power for street car purposes in other cities, the same shall be adopted by this company and the use of poles and wires dispensed with. G. C. M.

Ann Arbor, Mich., July 31, 1890.

Mr. John A. Enos, an inventor of the electrical persuasion, wants Congress to pay him $60,000 to put in his patent double back action electrical vote-recording device, whereby, as he says, the "yeas and nays" may be taken and recorded in a mere fraction of the time now required. Bless your innocent heart, Mr. Enos, you utterly fail to catch the idea. The "yeas and nays" are chiefly taken to kill time, and legislators already complain that the practice has made the clerks so perfect and expert in the work that, to consume the same amount of time, the roll call must now be gone over three times where formerly once sufficed.—*Boston Post.*

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire, Electrical Securities, 18 Wall street, N. Y., Saturday, August 9. New York, Boston and Washington Stock Exchanges.

NEW YORK.

Western Union Telegraph Co	83.
Edison General Electric Co	30⅝.
" " " Deferred	94.
Consolidated Electric Light	60.
Edison Electric Illuminating Co.	70.
United States Electric Light	35.

BOSTON.

Thomson-Houston Electric Co	50.
" " " Preferred	25⅛.
" " " Series C	12¾.
" " " Series D	6¾.
" " International	
" " Welding Co.	
" " European Welding Co.	90.
Ft. Wayne Electric Co	12½.

TELEPHONE:

American Bell	225.
Erie	*52⅜.
New England	52½.
Mexican	80
Tropical American	1¼.

MISCELLANEOUS:

Edison Phonograph Doll	3⅛

WASHINGTON.

Pennsylvania Telephone	25.
Chesapeake and Potomac	*77.
American Graphophone	16.
United States Electric Light (Washington)	165.
Eckington and Soldiers' Home Railway	60.

*Ex. Dividend.

A New Switch for Overhead Electric Railway.

The Illinois Electric Material Company, of Chicago, have put on the market an overhead switch for electric railway service of a very simple and practical design. The accompanying illustrations will explain its workings.

In Fig. 3, we give a view of the plan of the switch: A—B and C—B represent the two tracks. In Fig. 1 the car is traveling along the track A—B. When the trolley wheel reaches the point E, it opens a space wide enough to allow the trolley wheel to pass. After the wheel has passed, the fin springs back into its original position. When the car is traveling on track B—C, as shown in Fig. 2, the fin E—D is passed over to E—C, allowing the trolley wheel to press along the track B—C.

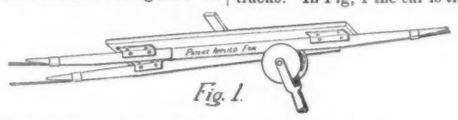


Fig. 1.

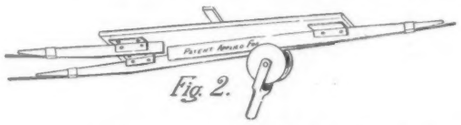


Fig. 2.

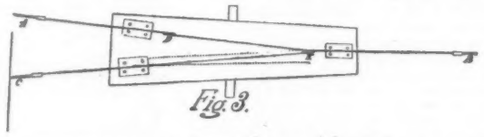


Fig. 3.

Practical experience is said to have demonstrated the impossibility for the trolley wheel to jump the track, no matter at what speed the car may be running. The base on which the fins are placed is galvanized sheet iron, and the fins, or more properly, the switches, are made of the best saw blade steel.

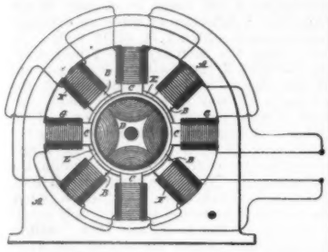
The trolley wires are fastened by clamps to the ends of the switches, and do not necessitate soldering. The whole is supported by guy wires fastened to lugs extending at right angles to switch, as shown in Fig. 3.

A Clock That Never Runs Down.

Darius L. Goff, of Pawtucket, Rhode Island, who has a fancy for mechanical curiosities, possesses a clock that is said to never run down. Through an ingenious contrivance it is kept wound by the simple opening and closing of the front door of the house. Electrical appliances, operated by the running of the clock, raise the gas jet in the hall at dusk, and lower it at bed-time; ring an early-rising bell for the servants, a later one for the family, and, an hour later, the breakfast bell; and when the hour is struck, musical cathedral chimes respond in the chambers of the house.

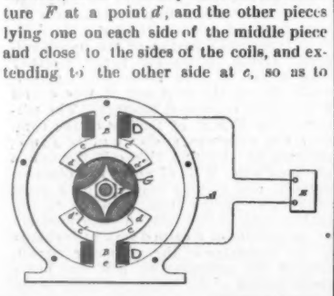
RECENT NOTABLE ELECTRICAL PATENTS.

Several interesting patents have been granted to Nikola Tesla for alternating current motors. In one of these, illustrated in the accompanying engraving, an armature provided with a closed circuit such as is commonly used in alternating current motors, is placed in a magnetic field comprising an annual series of regularly arranged laminated cores having their inner ends in close relation to the armature, and their outer ends secured in magnetic connection with a laminated iron cylinder or ring, marked *A* in the engraving. The poles are divided into two sets, one of which, *C*, has



its inwardly projecting extremities connected by a magnetic bridge of iron, marked *E*, the other set of poles being disconnected at the inner ends. The coils surrounding the poles are grouped in two sets, both connected with an alternating current circuit. The principle upon which a rotary torque is imparted to the armature when an alternating current flows through the field magnet coils depends upon the difference in time required for free magnetism to be displayed at the ends of the two sets of polar projections. By reason of the magnetic bridge *E* connecting the members of one group of pole pieces, it requires a sensibly longer time to saturate the pole pieces *C* than it does to saturate the pole pieces *B*, and although the same alternating waves of current pass through both sets of coils, the set *C* will be later in acting on the armature than the set *B*, which results in a rotary torque on the armature by reason of the action excited by the pole pieces *C* upon the poles induced in the armature by the pole pieces *B*. As the successive waves of current pass through the coils of the field magnet, therefore, a continuous rotary effort will be imparted to the armature.

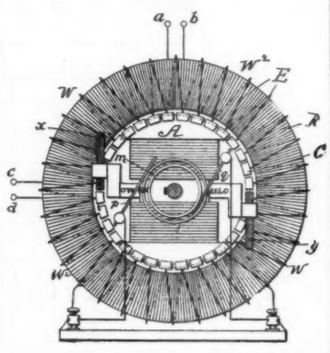
A fair idea of the principle of operation of the other motor of Mr. Tesla, referred to above, may be gathered from an inspection of the accompanying engraving in connection with a few words of explanation. The principle upon which this motor depends is that a longer time is required to magnetize an interior portion of the core of a magnet than the portion lying in close relation to the surrounding coils. In the illustration, *E* is a source of alternating current, the waves of which circulate in the field magnet coils *D D*, each of which is provided with a core composed of several laminations of iron, the middle one, *c'*, being extended to one side, so as to closely embrace the armature *F* at a point *d'*, and the other pieces lying one on each side of the middle piece and close to the sides of the coils, and extending to the other side at *c*, so as to



embrace the armature at a different circumferential position. When an alternating current flows through *D* it requires a longer time to magnetize the polar extremity *c' d'*, for the reason that the core piece of which it is an extension is further away from the conductor constituting the exciting coil. The poles *d* will, therefore, induce a polarity in the armature, and the latter will be given a rotary torque by the attraction exerted by the poles *d'* which reach a condition of maximum magnetization a little later than the others. The armature may be wound as shown with closed coils, as usual in the construction of alternating current motors.

CONVERTING ALTERNATING CURRENT INTO CONTINUOUS CURRENT.

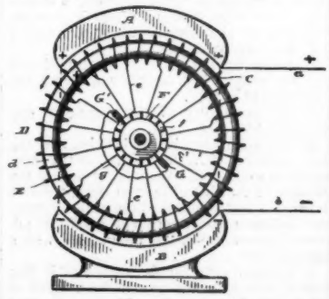
Messrs. Zipernowsky and Deri have patented a converter intended to convert alternating current into continuous current. The device comprises essentially a ring core on which are wound two sets of coils placed in circuit with two alternating currents differing in their time periods a quarter of a phase. Upon the same core as the coils just mentioned, is wound a continuous Gramme coil. Within the ring is placed an armature provided with a closed circuit to which is imparted a continuous rotary motion by the rotating poles developed in the ring core by the alternating currents differing in phase. The Gramme coil is connected at various points round the ring with a commutator in a manner well understood. Brushes carried by the rotating armature take the induced current from the strips of the commutator, whence it is led through ring contracts and brushes to an external circuit. The armature following the polar lines developed in the ring core, causes the collecting brushes to travel synchronously with the magnetic waves traveling through the ring, such waves



cutting the convolutions of the Gramme conductor always in the same direction, thus developing a continuous current, which is led into the circuit by means of the ring contacts and fixed brushes above referred to. The accompanying engraving illustrates the structure of the device.

ALTERNATING CURRENT MOTOR.

An alternating current motor has been patented by C. J. Van Depoele in which a rotating iron ring similar in construction to the ring of the Gramme motor has currents induced in its core by laminated pole pieces excited by an alternating current. The commutator of the rotating ring is provided with brushes electrically connected so that the ring coils are at all times in a closed cir-



cuit. The brushes determine the polar line in the ring, and can be shifted to a position of adjustment for a maximum rotary effort. The rapid reversals of magnetism in the pole pieces induces currents in the ring coils, and these secondary currents are utilized to develop a consequent polar point in the ring and create a rotary torque between the ring and the fixed pole pieces.

THERMO-ELECTRIC ELEMENT.

E. N. Dickerson has patented a thermo-electric element composed of an alloy of 60 per cent of antimony and 40 per cent. of zinc, covered at the point where the heat is applied by a metallic casing.

ELECTRIC SOLDERING IRON.

An electric soldering iron has been patented by C. E. Carpenter, in which the head of the instrument is a hollow cone of copper containing a metallic plug, between which and the inner surface of the cone is a

coil of fine wire separated from the plug and the face of the cone by means of layers of asbestos. The ends of the resisting wire are connected by conductors passing through the handle of the tool with any suitable source of current.

DUPLEX CONDUCTOR.

An improvement in flexible conducting cords has been patented by E. T. Warner,

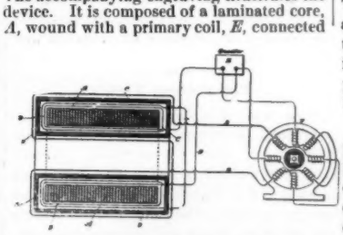
of Chicago. As shown in the accompanying engraving, it comprises two strands of tinsel or other flexible conducting material surrounded by a cotton envelope *a* or *b*, semi-cylindrical in shape. The strands are wound with a serving of cotton *e*, then wound with a coil of steel wire *d* to prevent injury from heavy pressure, and then braided with a covering, as shown at *e*.

ELECTRIC ARC LAMP.

Samuel P. Parmly, of Chicago, has patented an arc lamp in which duplicate carbons are carried by the upper carbon holder, and co-operate with a wide lower carbon, which, it is claimed, will form an arc with a lower voltage than lamps having single upper and lower carbons. When the lamp is out of operation, the two upper carbons normally rest on the lower carbon. When the current is applied, an arc will be established between one of the upper carbons and the lower carbon; in the process of burning, that carbon which happens to first establish the arc will induce the formation of a sort of cone in the lower carbon, and the adjacent portion of the latter will scale away after a time. In the process of feeding and burning, the active carbon will come into contact with the flat carbon, extinguishing the arc and permitting the twin upper carbon to come into action. It is claimed for this lamp that it will burn much longer and at a lower voltage than the lamps now in use.

TRANSFORMERS.

Nikola Tesla has been granted a patent for a transformer or induction device for causing a lag or difference of phase in alternating currents to render them useful in operating his alternating current motors. The accompanying engraving illustrates the device. It is composed of a laminated core, *A*, wound with a primary coil, *E*, connected



in circuit with the alternating current generator, an iron sheath *C* being interposed between the primary coil and the secondary coil *e*; the latter coil is connected in circuit with one set of coils of the motor and the currents developed are a little later in time than the alternating current furnished by the generator *E*. The sheath *C* it is claimed increases the amount of lag of the secondary current behind the primary current, but little induction occurring in the secondary coil *B* until the sheath *C* has been saturated with magnetism.

The Rest of Those Lights.

The Gas Commission awarded contracts on August 7, for lighting the 209 electric street lights not included in the schedules previously passed. They were left out because the companies wanted a higher price than they charged last year. On the date mentioned, the Commission received an agreement signed on behalf of the companies to light the 209 lamps at the old rates for the rest of the year. In doing this they assume a serious loss, but they do not wish to inconvenience the public. They also call upon the authorities to examine into the actual cost of street lighting.

—— The Columbus, Ind., council has purchased an electric light plant at a cost of $9,000.

—— The Thomson-Houston Company has arranged for the immediate establishment of an electric lighting plant in Exeter, N. H.

—— Citizens and manufacturing companies of Columbia, Pa., are anxious to have established in their town an electric plant to furnish light and power.

—— Among the buildings consumed by the terrible conflagration in Seneca Falls, N. Y., last week, was the Thomson-Houston electric light plant. The loss was $100,000, with $10,000 insurance.

—— The Westinghouse Electric Manufacturing Company has just sold a 40-light dynamo of its alternate current arc light system, to go to Three Rivers, Mich.; there to be used by the electric lighting company of the town.

—— The Westinghouse Electric Manufacturing Company has obtained the contract for furnishing its alternating current apparatus to a company recently organized in Bryan, Tex. The plant will have a capacity of 500 lights.

—— The electric light plant at Anderson, S. C., is now being installed. The National Company's transformer system of incandescent electric lighting has been adopted. The plant at Rock Mill, S. C., of the same system, will also be installed in a few weeks.

—— Washington, Ga., is to be illuminated by the alternate current system of electric lighting. The Westinghouse Electric and Manufacturing Company has been awarded the contract for the installation of its apparatus for a capacity of 500 lights.

—— A very successful horse sale took place in New York City one night last week under the electric light. The light brought out the points of the horses as well as if they were standing in the sun. It was a decided novelty, probably being the first affair of the kind ever attempted.

—— An alternating current central station plant of incandescent electric lighting is about to be established in Waycross, Ga. The company organized there has just awarded the contract for the apparatus to the Westinghouse Electric and Manufacturing Company. The plant will have a capacity of 750 lights, and the installation will be at once commenced.

—— The Thomson-Houston Electric Light Company, at Burlington, Vt., is about completing the foundation for a new 1,800 incandescent light dynamo. This, with their present plant, will give capacity for 2,600 incandescent and 100 arc lights, making the largest plant in the State. At present they have 550 horse-power, which will be increased in the near future, and electric motors will be added to the business.

—— Helena, Montana, as the capital of that youthful State of the Union, is showing all other cities and towns a good example, by improving her illumination. A number of its enterprising citizens, who have established an electric light company, are now erecting a plant both for arc and incandescent lighting, with a capacity of 1,500 incandescent and 40 arc lights. The plant will be furnished with the alternating current system of the Westinghouse Electric Company.

—— The Edison Electrical Company, of Oakland, Cal., has issued a prospectus. It applied some time ago for a franchise but failed to get it. It has since bought out the Electric Light and Motor Company and will absorb it. It is said it will soon be incorporated with a capital stock of $500,000. The motor company's franchise, acquired by the new company, runs 47 years. The Edison system will be used for incandescent lights, and the Brush for street lights.

ELECTRIC CLUBS.

New York Electric Club.

Mr. Henry Hine, one of the real fishermen of the Club, will spend a week or two this month catching pickerel and perch at Thousand Islands.

It is reported that the first general meeting of the Club will be held in September, and an interesting programme will be arranged for that occasion.

Mr. A. R. Brewer, secretary of the Western Union Telegraph Company, gave a dinner party at the Club recently and all were highly pleased with the excellent service and *cuisine* of the Club.

Clark Hotchkiss, who died last week, was a diamond in the rough, says *The Metropolis.* In the palmy days of the Lotos Club, it was infected by a young Britisher who tried to borrow money upon the plea that his remittances from his London banker had been delayed. A large party of us were about to dine together, when the Britisher asked Hotchkiss for a temporary loan. "See here," said Hotchkiss; "if you will write a note to your banker, I will cable it to London free, and you will have the answer before the dinner is over. Upon that reply, I will lend you any reasonable sum. Sit down and write your letter." The Britisher made some excuse. "You are a fraud," said Hotchkiss, politely; "but don't let that interfere with the dinner. Take your seat, eat your fill, and never show your face here again!" All this transpired so quietly that only a couple of us overheard it. The Britisher obeyed orders. I never saw a merrier party, and Hotchkiss saved his $100 and rid the club of a swindler.

Chicago Electric Club.

The Pictures of Members of this Club continue to appear in the Chicago *Post.* In the issue of July 25th the countenances of C. H. Summers, Marmaduke M. M. Slattery, Charles H. Wilson and Mr. L. L. Summers, appear, with interesting biographies of each. Mr. Slattery is spoken of as follows:

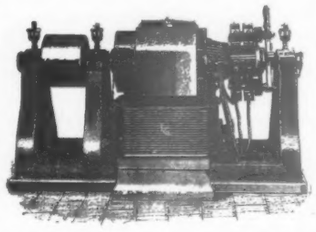
"M. M. M. Slattery, an electrical inventor on his own responsibility, is a native of Limerick, Ireland, and a B.A. allumnus of Marlboro College, England. He received his early training at the Limerick High School, and subsequently entered college when he graduated in 1873. His bent in life has never deviated from the path he mapped out for himself upon leaving school, and he has ever since devoted his time and talents to the study of electricity. His earliest work in that field was in connection with experiments in general electrical distribution, with St. George Lane-Fox, of England. He came to America in 1880 and entered the service of the United States Electric Lighting Company, and was employed in the department of electrical engineers for some time. Subsequently, Mr. Slattery started into the field of electrical invention on his own account, where he has since devoted his time. Among his inventions is a distributing apparatus used on arc light circuits in connection with incandescent lamps. He has also been prominent in the development of the so-called alternating current system of general electric distribution. He is one of the most prolific inventors of electrical appliances, being the inventor of the famous Slattery induction system of electric lighting, holds 104 patents relating to general induction apparatus and nearly as many more on other electrical devices. Mr. Slattery is a member of the Boston Society of Arts and of the Chicago Electric Club."

Get Out of His Way.

The person who wilfully stands up in front of the front seat of an open electric car and gets in the way of the elbows of the motor man is either persistently ignorant or egregiously selfish. The common instinct of self-protection, to say nothing of regard for the safety of others, should make passengers give the much-tried motor man all the room that he needs. Even if not actually and physically in the way, a passenger standing about the front platform is none the less a hindrance and a snare. The motor man has to consider him, to think more or less of the too near companion of his vigils, when he ought to have nothing in the world to consider but his brakes. Give the motor man elbow-room.—*Boston Transcript.*

The New Preece Dynamo.

The Preece dynamo, of which we present an illustration, was described as follows by our London namesake: In the Preece dynamo, the bed-plate and brackets are one complete casting. The plummer blocks are fitted with adjustable phosphor-bronze bearings, and each bearing is fitted with a sight feed lubricator. The magnet yoke, which is cast in one piece, is let into a recess in the be -plate, and the pole pieces are separate castings bolted to the magnet yoke. The field coils are wound upon



separate shells with zinc flanges, and are interchangeable for all machines of the same output. The armature is built up with charcoal iron disks insulated from each other with a specially prepared varnished paper, and are held in position on the shaft by two insulated bolts passing through the driving end plates which are firmly keyed to the shaft. The armature core is ventilated internally by suitable divisions being left at every two inches between the plates. The armature is wound one layer deep, with 19/17 strand braided cable, and connected up to a 60-part commutator, there being one complete turn per commutator bar.

The armature on the pulley side is provided with a blower to send a current of air through the pole pieces and prevent an accumulation of dust. Both ends of the armature are protected with brass shields fitted to the pole heads. The brushes are made of soft brass wire and their pressure upon the commutator is regulated by thumb screws.

At a speed of 800 revolutions per minute, the E. M. F. is 110 volts, and the current, at full load, 250 amperes, there being no sparking. The rise of temperature, after 10 hours' continuous run, is said to be 40 degrees on the armature conductors, and the field coils 30 degrees Fah. above the temperature of the air.

The Copper Swindlers.

The Paris Appeal Court has affirmed the sentence of six months' imprisonment imposed on M. Secretan for his connection with the questionable operations of the recent copper syndicate, but has reduced the fine of 10,000 francs imposed on him to 3,000 francs. The court rescinded the sentence of three months' imprisonment imposed upon M. Laveissiere, but sustained the decision of the lower court fining him 600 francs.

The Subway Fight.

Some time ago the North American Underground Telegraph and Electrical Company sued the Consolidated Subway Company, which is laying the New York subways, for $2,500,000 damages for an alleged violation of contract in discontinuing the use of the Johnstone system of subways, and got an order to show why the defendant should not be enjoined from using any other system. Argument was heard by Judge Beach, on August 7th, on the return of this order. C. W. Brooke, for the plaintiff, after asserting that the Johnstone system was a successful system and that the contract had been violated as set forth, and producing affidavits to that effect, declared that the Phœnix Construction Company, to which the Consolidated had delegated its authority under contract, was operated in the interest of the Western Union Telegraph Company and Metropolitan Telephone Company.

In reply, Mr. Cohen, of Hoadly, Lauterbach & Johnson, said that by the terms of the contract the defendant had agreed to lay the Johnstone conduit "so far as it may be practicable and desirable." The desirability and practicability were for the defendant to determine, and the Court would not enforce a specific performance. The whole case depended upon the contract.

Mr. Brooke did not agree with Mr. Cohen, but Judge Beach intimated very strongly that Mr. Cohen's contention was correct. He reserved his decision, taking the papers. The plaintiff's affidavits contain 95,000 words.

THE SECONDARY BATTERY.

(*Continued from page 7.*)

on breaking the charging circuit, and in consequence of a similar rise in the E.M.F. on breaking the discharging circuit, the voltmeter deflection continues to vary for several minutes after the circuit is broken. Hence, the value of E, measured by a voltmeter which is not infinitely dead beat, must be too small during charging and too large during discharging; and, consequently, since the above formulæ for the resistance are only true when V and E are the *simultaneous* values of the P.D at the terminals of the accumulator and of its E.M.F., it follows that the resistance has hitherto been measured too large, both in charging and discharging.

The magnitude of the error that has been thus made in different experiments depends, of course, on how dead-beat a voltmeter was employed, and, consequently, on how long a time was allowed to elapse between the breaking of the main circuit and the taking of the reading. For example, we find that towards the end of the charge with the normal current of nine amperes, the E. M.F. varies about one per cent. in 20 seconds after the circuit is opened. Now, as the difference between V and E, which measures the resistance, is only of the order 0.1 volt when it has its maximum value during the normal charge or discharge—that is, of the order four per cent. of E—it follows that an error of one per cent. in the measurement of E would make an error of about 25 per cent. in the measurement of the resistance.

To measure the resistance accurately, we ought to be able to measure the difference between V and E to $\frac{1}{1000}$ of a volt, and, therefore, as E is about two volts, the voltmeter must be very sensitive, with a long, open scale, and the needle must move through a considerable angle; whereas, in consequence of the rapid variation in E, the voltmeter must be very dead-beat—a condition almost incompatible with a long range and great sensibility.

These two conditions, however, we have fulfilled by the employment of the following device, by means of which the difference between the values of V and of E was measured to the $\frac{1}{1000}$ of a volt at identically the same moment that the values of V and A were measured. The process was as follows:

1. The sensibility of the voltmeter was adjusted so that 12 volts produced a deflection of 600 divisions, and V, the P.D at the terminals of the four accumulators under test, was measured.

2. A compensating E.M.F. was introduced into the circuit just sufficient to bring the spot of light to zero.

3. The sensibility of the voltmeter was increased 60 times.

4. The main circuit was broken, and the time variation of E, the E.M.F. of the accumulators under test, observed by noting the position of the spot of light at the successive ticks of a metronome, whose rate of going was before each experiment carefully adjusted by comparing the metronome with a chronometer.

5. A time curve for the values of E was drawn, and by producing it back until it cut the line passing through time 0—that is, the time when the main circuit was broken—we obtained the value of E at the same moment that the values of V and A were measured.

The apparatus employed is symbolically shown in Fig. 10. C_1 are the four accumulators under test; when they were being charged by means of the accumulators C_2, a bridge-piece was placed so as to join the mercury cups 7 and 8; whereas, when C_1 were being discharged, mercury cup 7 was joined to 9 instead of to 8. In both cases the current passed along the thick lines through an A. and P. magnifying spring ammeter, whose indications furnished an approximate measure of the current, through an adjustable carbon resistance and a platinoid strip which could carry the maximum current, 10 amperes, used in these tests, without its resistance being preceptibly altered. To two points of this strip were soldered two wires going to the mercury cups 10 and 13: these were joined, respectively, to 11 and 12 in charging, and to 12 and 11 in discharging, so that the current always went through the D'Arsonval galvanometer A in the same direction. This galvanometer then measured the charging or discharging current, its sensibility being such that for a current of nine amperes passing through the circuit a deflection of 600 scale divisions was produced when the resistance in d was 185 ohms, that of the galvanometer A itself being 52 ohms.

By joining the mercury cups 1 and 2 with a bridge-piece, the P.D. between the terminals of the accumulators under test, C_1, could be measured with the voltmeter V; the sensibility being such that with a resistance of 791 ohms in a, and 63,696 ohms in b, a deflection of 600 scale divisions corresponded with a P.D. of 12 volts. By connecting the mercury cup 1 with 3, instead of with 2, the resistance b was cut out of the circuit, and the sensibility of the voltmeter V was increased 60 times. If, now, 4 were connected with 5 or with 6, and the sliding contact S moved along the thick wire WW, a point could be found such that no current passed through the voltmeter V. Next, the main circuit indicated by the thick wires was broken, when the spot of light would move quickly across a portion of the scale, and then continue moving right across the rest of the scale. The first part of this motion was, of course, due to the sudden variation of the P.D. at the terminals of the accumulators C_1, on the current through them being stopped, while the continuation of the motion was due to the subsequent variation of the E.M.F. of these accumulators after the current was stopped. And the value of

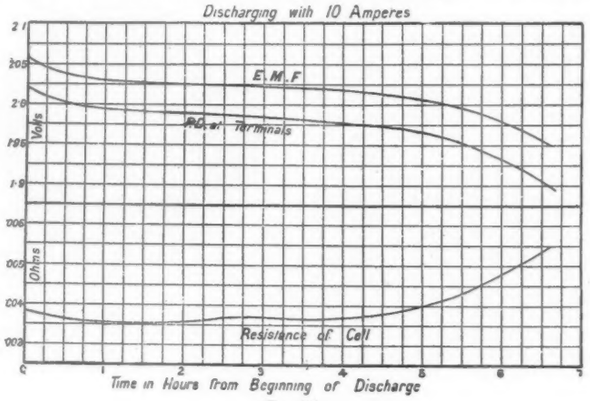


FIG. 13.

the E.M.F. at any moment was equal to

$$V + \frac{0.2d}{600},$$

where d was the deflection of the voltmeter spot of light at the moment in question, and V was the P.D. between the terminals of the cells C_1 just before the main circuit was broken, and which was measured by the voltmeter deflection when mercury cup 1 was connected with 2. In discharging, the + sign was, of course, used, and in charging, the — sign.

This P.D. at the terminals of the four accumulators under test, C_1, and which had to be balanced by the E.M.F. of the accumulators C_2, approached 9.6 volts towards the end of a charge, while it fell to 7.6 volts at the end of a discharge. In the former case the E.M.F. of four cells and a portion of the fifth of the compensating accumulators C_2, was employed, while in the latter the E.M. F. of three and a portion of the fourth sufficed. Hence, during the charge, mercury cups 4 and 5 were connected together, while during the discharge it was 4 and 6 that were connected together. The portion of the E.M.F. of the last of the compensating cells was, as shown in the figure, obtained by shunting this cell through a platinoid wire, WW, of about two ohms resistance, and making contact with a point of this wire farther from, or nearer to, the positive pole of this cell. This adjustment of the position of S caused very little change in the resistance of the voltmeter circuit, because the resistance of WW was but a small portion of the entire resistance in the voltmeter circuit.

This method of measuring the resistance of accumulators was applied by three of the students of the Central Institution—Messrs. Muller, Stephens and Wightman—to determine the variation of the resistance during the entire discharge of the cells with ten amperes, and charge with nine; further, during May and June of this year Mr. Muller has, with great perseverance, being making an uninterrupted series of observations, day and night, to determine the resistance during the entire discharge and charge for various cur-

rents. For each of these currents the cells are being brought to a steady working state by many discharges and charges being successively and without interruption made with each current. In the case of the small current, the time of a charge and discharge is tediously long, the charge, for example, with three amperes requiring 40 hours to raise the P. D. from 1.9 to 2.4 volts per cell, so that several weeks have to be spent obtaining the resistance for this current. This investigation of resistance is not yet completed, and, therefore, we do not propose in this paper to refer to the variation of the resistance of a cell with different currents when the cell is brought to a *steady working state for each current*. Such an experiment has not, as far as we are aware, ever before been attempted with accumulators, former observers having contented themselves with merely observing the variation of the resistance when the current during the discharge or charge was abruptly changed from one value to another. This is a very different thing from ascertaining how the resistance of an accumulator varies with the current when *each* of the different currents employed is steadily used for some weeks in the discharging and charging of the cell, until the cell has arrived at a steady working state for the current in question.

We give in Fig. 11 an example of the time fall of the E.M.F. on breaking the circuit for eight periods of 20 seconds during the charge. The curves are all drawn to the same scale, but, in order to get the curves into a reasonable space, a different zero line has been employed in drawing each curve. The actual E.M.F. in volts per cell is given for several points on each curve, so that the time rise at any period of the charge can be easily seen. The E.M.F. at the moment of breaking the circuit in each case is, as already explained, obtained by seeing at what point the curve cuts the vertical line through the time 0. The value of this point in volts is, in fact, what an infinitely dead-beat voltmeter would indicate immediately after the circuit was broken. It will be observed that the time fall of E.M.F. on breaking the circuit becomes more and more rapid as the charge continues.

The top curve in Fig. 12 gives the P. D. at the terminals of one accumulator, charging with nine amperes, while the second curve gives the *simultaneous* values of the E. M. F., being, in fact, the curve drawn through points whose abcissæ are the times —0 hours 37 min., 1 hour 36 min., etc.—for which the eight curves on Fig. 11 are drawn, and whose ordinates are the values of the points where these curves cut the vertical line drawn through the zero of time in Fig. 11, or time when the charging circuit was broken. The lowest curve on Fig. 12 gives the resistance of the cell at any moment during the entire charge with nine amperes, the ordinates of this curve being calculated from the formula

$$\frac{V-E}{9},$$

where V and E are values of the P.D. and the E.M.F of the cell at the same instant.

As the charging proceeds, the resistance of the accumulator at first falls, and reaches a minimum; it then increases, at first slowly, but as the charging approaches the finish, the resistance rises very rapidly, so that when the P.D. per cell is 2.4 volts, the resistance is five times as great as its minimum value, which is reached shortly after the commencement of the charging. Taking 0.045 ohm as the average resistance during charging, and remembering that there are in these cells two positive plates, each surface of which is 9¼ into 9¼ inches, and that all four surfaces are equally active, it follows that the mean resistance of the 1888 E.P.S. type of cell while charging with the maximum current density allowed —viz: 3.787 amperes per square foot—is about 0.11 ohm per square foot of positive plate.

Fig. 13 gives the P. D. at the terminals of one of the cells during the whole of a discharge with 10 amperes, the simultaneous values of the E. M. F. and of the resistance. The resistance at the commencement of the discharge is a little higher than at the commencement of the charge, and the minimum value to which it diminishes is not as low as the minimum attained by the resistance in charging. At the end of the fifth hour of discharge and charge the resistance is practically the same. After that, however, there is a marked difference: the resistance in discharging does not rise as rapidly as in charging; and hence, since, in addition, the time of a discharge is necessarily less than of a charge, the resistance never reaches as high a value in discharging as in charging.

If we take 0.038 ohm as the mean resistance during a discharge with 10 amperes, then it follows that the mean resistance of the 1888 E. P. S. type of cell while discharging with the maximum current density allowed—viz., 4.208 amperes per square foot—is about 0.09 ohm per square foot of positive plate.

Both in charging and in discharging with constant currents, the greater part of the time variation of the P. D. at the terminals of an accumulator is due to an actual variation in the E. M. F. itself; and it is only towards the end of the charge and of the discharge, when the resistance of the cell becomes relatively large, that the slope of the P. D. curve becomes practically different from that of the E. M. F. curve.

We may mention, in conclusion, that the results which we have obtained with accumulators, made to go for long periods through definite cycles in charging and discharging, have been so interesting that we are now engaged on the design of an apparatus which will automatically keep the current constant for any time at any pre-arranged value, which will automatically change over from charge to discharge, or from discharge to charge, when the P.D. per cell reaches any pre-arranged limit, and which will record the P.D. at the terminals of the cell and also its E.M.F. during the whole period.

We hope, therefore, at some future period, to be able to present a graphical record of the life history of accumulators, from their first formation to their death.

A Novel Feature in Incandescent Switches.

Simplicity of construction, efficiency in operation and cheapness, are the three main points which are looked for in any good article. These three points are combined in the new "Convention" incandescent double pole switch, which we illustrate below, and

which is manufactured by the Illinois Electrical Material Company, Chicago.

The interior view shows the contact bar resting on the insulated ratchets. To form the circuit it is only necessary to turn the handle to the right and the bar will climb the grade and take a horizontal position on the brushes fixed on both sides, while a second turn gives an instantaneous brake,

the bar being thrown, by the force of the spring, about three-sixteenths of an inch. The ratchets are made of insulating material, as is also the block supporting the contact bars and the small slot cut sideways in the center block aiding to throw the contact bar of the ratchet the necessary distance. To convert into a single pole switch it is only necessary to remove the outer contact brush.

The Electric Mutual Insurance Company.

At a meeting of the members of the Electric Mutual Insurance Company, at its office in Boston, on the 5th inst., the following named gentlemen were added to the Board of Directors:

F. S. Hastings, of New York, secretary and assistant treasurer of the Edison General Electric Light Company.

Marsden J. Perry, of Providence, R. I., manager of the Narragansett Electric Light Company, and president of the National Electric Light Association.

A. M. Young, of Waterbury, Conn., secretary of the Connecticut Electric Construction Company, and

John I. Beggs, of Chicago, general Western agent of the Edison General Electric Light Company. Another representative of the Westinghouse interests will be added as soon as he is named by that company. That will make a full board of 15 directors.

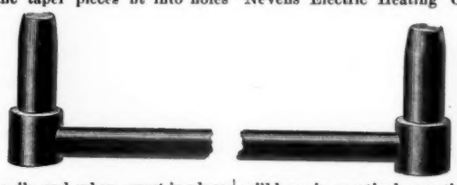
The ten who were originally elected and who were also the incorporators and all residents of Massachusetts, as required by law, are as follows:

F. A. Gilbert, president Boston Electric Light Company, and also president Massachusetts Electric Light Association; General Benj. F. Peach, assistant treasurer Thomson-Houston Electric Company; Hon. T. C. Bates, director Worcester Electric Light Company; Hon. Elisha Morgan, president United Electric Company, of Springfield, Mass., and also president Morgan Envelope Company, of Springfield; E. W. Burdett, treasurer Citizens' Electric Light Company, East Boston, and counsel for the Boston and other electric light companies; C. L. Edgar, general manager Edison Illuminating Company, of Boston; Robert B. Taber, recent manager New Bedford Gas Light Company; Thomas T. Robinson, president Dedham, Mass., Electric Light Company, and an officer in several other local companies; Stephen E. Barton, president of the Electric Mutual, and William Brophy, chief inspector of the company.

New Work of the Great Western Electric Supply Company.

AN ALL COPPER RAIL BOND.

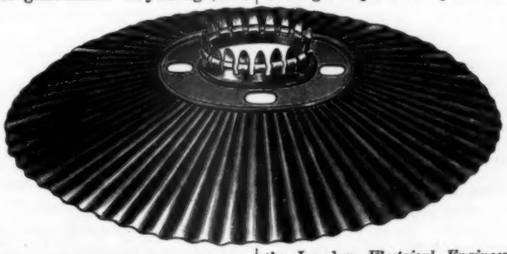
In electric railways with overhead wires, the resistance of the ground return and the consequent loss of energy will depend largely on the connection between adjoining rails. The various forms of rail bonds now in use are made wholly or in part of iron and still leave better conductivity to be desired. To fill this want, the Great Western Electric Supply Company are making a rail bond entirely of copper. The cut shows the two end pieces and part of the connecting wire, full size. The taper pieces fit into holes



drilled in the rails and when upset in place they form a good metallic connection. The connecting piece can be made of any desired diameter and length, to suit the different circumstances, and can be bent to meet any unusual change. This rail bond does away with the brass and iron pieces formerly used, and should give a joint of practically no resistance.

A NOVEL CONE SHADE.

Tin shades being cheap and unbreakable, there has always been a call for them from factories, mills, stores and other places, where porcelain shades would prove too costly. The more so as the bright tin reflects the light better than the expensive porcelain or glass shade. A year ago, Mr.



Geo. Cutter, now manager of the Great Western Electric Supply Company, went a step farther and designed a tin shade that required no holders. The popularity of this "combination tin shade," of which 20,000 are now in use, has now led the above firm to bring out a new pattern called "Cutter's Combination Cone Shade." As the cut shows, it is of a deep cone shape, making it well fitted for the use of bookkeepers, draughtsmen, engravers and others who want the light concentrated on their work. As it fits the Thomson-Houston, Westinghouse and Sawyer-Man sockets directly, it is bound to hang square at all times. Its convenience, together with its cheapness, will probably cause it to be widely used for lights over desks and the like.

The Minneapolis Electrical Exhibit.

TO THE EDITOR OF ELECTRICAL REVIEW.

The electrical exhibit which is to be made at the Minneapolis Exposition, which opens August 27 and closes October 4, will be the most complete display ever made. It will include not only the Edison exhibit, as made at the Paris Exposition in 1889, but will be more complete in every way, and in addition an exhibit by the Thomson Electric Welding Company, of Lynn, Mass. The Edison exhibit is already on the ground and is being arranged under the direction of Luther Stieringer, of New York. Nearly three car loads of electrical material, to be used in the exhibit, has arrived. The principal feature is a Tower of Glory, the plans for which were drawn by Mr. Stieringer. The tower has been built in the center of the building and is about 70 feet high and eight feet in central diameter, it is of Egyptian design, and is to be covered with 7,500 incandescent lamps. From the top of the tower, festoons of lamps will hang in various designs, making it the most brilliant lighting spectacle in the world.

The Edison exhibit includes the wonderful talking dolls, an electric railroad, the arious telephone patents, the telegraph instruments, as seen in Paris and at the Lenox Lyceum, the phonographs and dynamos. The workings of all this apparatus is to be illustrated by experts from Edison's laboratory.

The Thomson electric welding apparatus, by which dissimilar materials are united, will also be in actual operation. Much interest is being manifested in the exhibit.

The convention of the Edison Illuminating Company will be held in Minneapolis, September 16. A large number of delegates are expected to be present. There will also be a very extensive exhibit by the Carpenter-Nevens Electric Heating Company, who will have in practical operation a number of very recently patented electrical apparatus, soldering tinware, ironing laundry work, pressing clothing, frying doughnuts, and various other appliances of heat by electricity. There will also be a very extensive exhibit by the power department of the Edison General Company, and a very extensive line of exhibits and electrical merchandise and apparatus. R.

Minneapolis, Minn., August 8.

Ferranti Mains in Trafalgar Square.

The roadway leading past the lions in Trafalgar Square is up as we write, says the London *Electrical Engineer*, and the workmen are busy laying the Ferranti trunk mains joined in the manner we recently described. Four of these 10,000-volt mains are laid side by side in two wooden troughings, separated from touching by wooden slips and filled around with melted bitumen. The mains, ready jointed in lengths, seem easy to handle and have a certain flexibility that allows of easy laying. They are, doubtless, intended to take the main current from Charing Cross on to the Grosvenor.

Ohmsby—"They ought to have made Kemmler read the 'Kreutzer Sonata,' instead of turning a current into him."

Voltston—"Why so?"

Ohmsby—"Because it's so shocking."

A NEWSY COLUMN.

The Edison Convention.

It is announced that the annual convention of the Association of Edison Illuminating Companies will be held at the West Hotel, in Minneapolis, Minn., on September 16th. A large attendance is expected.

A Gang of Wire Thieves.

The electric light companies of New York city have been suffering considerable losses at the hands of an organized band of wire thieves. A foreman is in charge of the gang and gives them orders openly to remove wire. The Board of Electrical Control furnishes all the companies with badges for their foremen, and it would seem as if this fact offered the police a means of detecting the guilty parties.

Phonograph Toy Company.

The Edison Phonographic Toy and Automaton Company, Limited, has been formed in London, to acquire exclusive rights, free of royalty, for Great Britain, Ireland and continental Europe, in Edison's phonographic patents as applied to toys, dolls, etc., also Jacques' improvements on the same, for £270,000, payable, £100,000 cash and the balance in cash or shares, as the directors may determine. The capital stock is £300,000 in £1 shares.

Another for Westinghouse.

The commissioner of patents has just rendered a decision of great interest to the Westinghouse Electric Company. It was a case where De Ferranti, of England, sought to establish priority of invention of an electric converter used in the alternating system. De Ferranti claimed that two specifications, one a provisional and the other a specific one, appeared in England as early as 1885, and again in 1886, and that they were sufficient ground for the establishment of priority in the United States. The commissioner held, on the contrary, that the specifications were secrets of the English patent office, and, therefore, Mr. Westinghouse could not have been cognizant of them.

Hypnotizing by Electricity.

At a recent meeting of medical societies in Hanover, N. H., Dr. J. Leonard Corning, of New York, read a paper on "Hypnotism." After describing various means heretofore employed for the purpose of inducing a hypnotic state, Dr. Corning exhibited a most ingenious electrical appliance, by the aid of which it is possible to hypnotize the patient without much exertion on the part of the physician. The apparatus in question consists of a glass wheel, ornamented with cut glass jewels, which is driven at great speed by an electric motor. By regarding this glass wheel fixedly for from 10 minutes to half an hour, the patient, especially after a few trials, is easily thrown into the hypnotic state or sleep, and it is then possible to influence his imagination to a prodigious degree by the aid of suggestions.

A Long Electric Road.

A syndicate of Pittsburgh and Boston capitalists is backing the Chicago and Lake Shore Electric Railway, for which a license for incorporation was taken out at Springfield last week, with F. L. Brooeks, C. H. Remy and George O. Fairbanks, of Chicago, mentioned among the incorporators. But little is known of the plans and purposes of the electric company beyond the fact that the road will probably be commenced early this Fall. Ground will first be broken on the North Side, and the road then rapidly pushed to completion to the northern limit of Fort Sheridan, 25 miles north of Chicago, on the North Shore. The line, it is estimated, will cost in the neighborhood of $1,500,000. The articles of incorporation may mean either a surface or an elevated railway. The road opens a magnificent suburban district.

A Corner in Carbons.

According to press dispatches, the Thomson-Houston Electric Company has just purchased the plant of the National Carbon Company, at Cleveland, O., paying $150,000 for it. It is also stated that they are negotiating for the Standard Carbon Company, of Cleveland. There are four carbon manufactories in that city, the Brush, National, Standard and the Globe. The two first mentioned are controlled by the Thomson-Houston Company, and the Standard and Globe Companies are independent. Those four concerns, it is said, manufacture 60 per cent., or 54,000,000 of the 90,000,000 carbons used annually in the United States. A factory owned by the Thomson-Houston Company at Fremont turns out 10 per cent. of the total production, but it is usually counted a part of Cleveland, and this city is given credit for 70 per cent. It is said that the output of the Globe Company is about 5,000,000 carbons yearly. There are two factories in St. Louis and two in Pittsburgh.

St. Louis Electrical Exposition.

The electrical exhibition which will be held in St. Louis this Fall, is expected to eclipse all previous efforts in that line. Mr. Fred H. Whipple will personally supervise and manage the whole affair. Many novelties are promised, among others an electric fountain. The following is a list of exhibitors up to date:

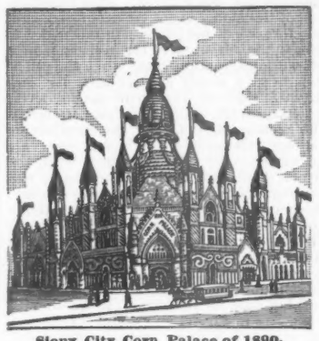
Stanley Electric Co., Philadelphia; apparatus for electrically filtering water.
Jenney Electric Motor Co., Indianapolis; motors and dynamos.
Fidelity Carbon Manufacturing Co., St. Louis; carbons and battery material.
C. H. Talmage, Kansas City; electric house heaters.
Joseph Irwin, Topeka; electric railroad signals.
G. F. Hackenberg, Austin, Tex.; electrical musical telegraphy.
John S. Melton, St. Louis, Mo.; electric foot specialties.
Royal Silk Manufacturing Co., New York; dynamo towels.
W. H. Jenkins, Denver, Col.; electric mining apparatus.
Hoover, Owen & Reutschler Co., Hamilton, O.; engines.
N. H. Edgerton, Philadelphia; motors and instruments.
Schultz Belting Co., St. Louis; belts.
Armington & Sims Engine Co., Providence, R. I.; engine for marine lighting.
Thomson-Houston Electric Co., Boston; marine dynamos, electric hoists and mining machines.
F. M. Sparrow, Boston; electric specialties.
Parker-Russell Mining Co., St. Louis; carbons.
Sperry Elect. Co., Chicago; motors and dynamos.
Chicago Belting Co., Chicago; belts.
Phœnix Engine Co., Meadville, Pa.; engines.
Sioux City Engine Co., Sioux City, Ia.; engines.
St. Louis Electrical Supply Co., St. Louis; general electric supplies.
Walter E. Crane, Minneapolis; electric oil filters.
Fisher Electric Co., Detroit, Mich.; dynamos.
Foree Bain, Chicago; dynamos.
Carpenter-Nevins Electro-Heating Co., Minneapolis; domestic heating appliances.
Rose Electric Light Supply Co., St. Louis; dynamos, motors and lamps.
Buckeye Engine Co., Salem, O.; engines.
Edison Electric Co., New York; dynamos.
John T. Noye Mfg. Co., Buffalo, N. Y.; engines.
Western Electric Co., Chicago; dynamos.
Knapp Electrical Works, Chicago; motors and domestic electrical supplies.
Southern Electrical Supply Co., St. Louis; motors and supplies.
Electric Exercising Machine Co., Boston; electric exercising machines.
Franklin Electric Co., Chicago; electric cigar lighters.
Union Electrical Construction Co., St. Louis; general electrical apparatus.
Bennock Battery Co., Chicago; electric battery railroad.
A. L. Ide & Son, Springfield, Ill.; engines.
Kester Electric Co., Terre Haute, Ind.; dynamos and motors.
Johnston Electric Train Signal Co., Boston; model train of cars with electric signals.
Blattner & Adam, St. Louis; household supplies.
Connecticut Motor Co., Plantsville, Conn.; dynamos and motors.
Westinghouse interests combined; electrical and mechanical apparatus.
Sperry Electric Mining Machine Co., Chicago; electric mining machines.
Shay, Stevens & Co., Chicago; insulators and battery jars.
John Moran, Adair, Mo.; electric burglar alarms.
Simplex Electrical Co., Boston; wires and cables.
Washburn & Moen, Worcester, Mass.; wires and cables.
Automatic Clock Co., Syracuse, N. Y.; clock cutouts, etc.
Belding Motor Mfg. Co., Chicago; motors.
Page Belting Co., Concord, N. H.; belts.
A. C. Wolfram, St. Louis; domestic electric goods.
Great Western Electric Supply Co., Chicago; supplies.
Jewell Belting Co., Hartford, Conn.; belts.
Washington Electric Conduit Co., Washington, D. C.; underground conduits.
Russell Electric Lamp Co., Boston; arc lamps.
Buckeye Electric Co., Cleveland, O.; lamps.
Swan Lamp Co., Cleveland, O.; lamps.
Lockwood Instrument Co., Detroit; electrical instruments.
Novelty and Electric Co., Memphis, Tenn.; electric specialties.
Pond Engineering Co., St. Louis; engine and dynamo.
Samuel T. Williams, Baltimore, Md.; engines.
E. M. Turner, St. Louis; elevated electric railway.
Jackson Electric Engine and Telephone Co., Boston; electric engine and storage battery.
Gibson Electric Fixture Co., Philadelphia; electroliers.
Zeigler Bros., Boston; electrical apparatus.
Electrical Safety Co., Boston; electric protectors.
Fibrone Manufacturing Co., New York; insulating and ornamental materials.
De Kosenko & Hetherington, Phila.; electroliers.
"C. & C." Motor Co., New York.
Okonite Co., New York.
Central Electric Co., Chicago.
English, Morse & Co., Kansas City.
Unicycle Electric Elevated Railway Co., St. Louis.
Western Electrical Supply Co., St. Louis.
New York Insulated Wire Co.

The World's Fair Through English Spectacles.

The organizers of the "World's Fair" to be held at Chicago may safely be trusted to leave no stone unturned towards making their exhibition a thorough exponent of the development of American resources, but the choice of locality alone has already assured one satisfactory result which is bound to follow, independently of organization and individual enterprise. The holding of the fair at Chicago will bring home to the thousands of Europeans who will visit it, some idea of the extraordinary nerve and vigor that characterizes the commerce of the northwestern States, of which the capital city of Illinois is the busy mart and storehouse. Here, far better than in cosmopolitan seaboard cities like New York, New Orleans and San Francisco, which are, after all, nothing but gigantic landing stages, the foreigner will be able to study the vigor of the most typical American city in the Republic, and will carry away a just appreciation of the vast producing capacities of the northwest States. It is the more necessary that Englishmen, especially, should go and spy out this fruitful land for themselves, as capital from this country has recently found an important outlet in the States of which Chicago is the commercial center, and we have no doubt that as time goes on and the profitable nature of present investments is proved, the eyes of English investors will be turned more frequently in this direction. The gathering at Chicago will, therefore, be of inestimable value in bringing its capabilities before representative capitalists from this side of the Atlantic.—*London Financial Times.*

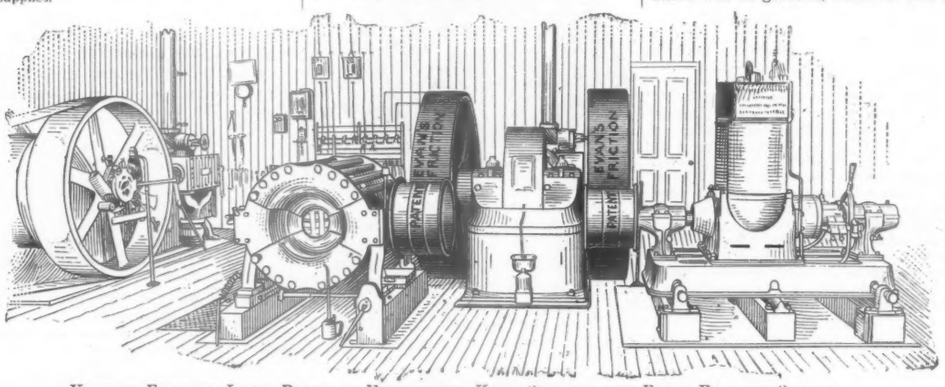
Electric Light in the Palace.

Electric Lights will play an important part in the decorations of the Sioux City Corn Palace for 1890. A special plant will be installed on the grounds. All the buildings, etc., will be illuminated by electric lights, and the effect of the decorations will be heightened by the profuse scattering of



Sioux City Corn Palace of 1890.
Opens Sept. 25. Closes Oct. 11.

lights throughout the buildings. For instance, in the central building there will be an open space, 78 feet across, without a post to interfere with the interior decoration. This will be covered with an artistically painted sky at a height of 65 feet. It will be studded with stars made of incandescent lamps, and the effect promises to be quite startling. The building will be so designed that the interior will be entirely novel in its construction, giving an idea of fairy land. There will be grottoes, beautiful and original ideas worked out in corn and showing the wealth of the great agricultural Northwest, as well as the ingenuity and artistic taste of its people. One of the features of the palace will be an immense waterfall, 40 feet in height, lighted by myriads of incandescent lights, ending in a large lake containing many kinds of fish. The falls will be located at the extreme northeastern corner of the palace, and will be the first thing to greet the eye of the spectator upon entering the main portals. At no time will the light of day enter the palace. A special electric plant of 250 horse-power will supply power for the dynamos which will be placed on the grounds. More than 3,000 incandescent lights and 50 arc lamps will be used in and around the palace.



VIEW OF ELECTRIC LIGHT PLANT AT HUTCHINSON, KAN., SHOWING THE EVANS FRICTION SYSTEM.

The Evans System at Hutchinson, Kan.

The illustration on this page shows the application of the Evans system of driving dynamos to the machines in an electric light station at Hutchinson, Kan. The dynamo on the left is a Thomson-Houston "M. D." with a capacity of 50 full arc lights, and the machine is running under full load. The Edison dynamo is a No. 16, with a capacity of 720 incandescent lights. They are both driven from the fly-wheel of an Armington & Sims engine. This plant has been in constant operation since last January and is giving perfect satisfaction.

Slightly Mixed.

A rather strange complication of poles and car tracks has come before the street department for settlement, says the St. Louis *Dispatch*. The Mayor some time ago gave the Lindell Railway Company a permit to lay temporary tracks on Delmar avenue from Union avenue to King's highway. The street is unimproved, neither sidewalks nor gutters being marked out. The company laid their tracks on either side of the street and went ahead running their cars.

Now the Bell Telephone Company comes along and gets a permit for a pole line over the same street. Under the general ordinance governing the erection of poles, they must be placed just inside the curb lines. When the line was run on Delmar avenue to determine the location of the poles, it was found that the line came right in between the rails of the Lindell Company's tracks. It is impossible to put the poles up right in the middle of the railroad track, and the telephone company will not put their poles anywhere else unless the railroad promises to pay the cost of moving them to their proper places when the sidewalk is established. The railroad company refuses to promise and refuses to move its tracks. How the matter will be settled is what the department is trying to decide.

Has He Got It?

Prof. J. Hirsh, a German chemist, of Chicago, in an interview, last week, asserted that he has discovered a process by which he can extract aluminum from common clay at a cost of 15 cents or less for each pound.

Aluminum, at present, costs $4 per pound, a fact which renders it practically useless, notwithstanding its remarkable qualities. The professor declares he has been working on the problem since 1865, and that he is not asking financial aid from any source, having already all the backing he wants. Two six story buildings have been leased by him, in which he proposes to begin work within a few weeks, turning out 300 pounds daily from the start.

If Chicago is soon to have cheap aluminum, there is no reason why the main hall of the Columbian Exposition should not be built of bright metal, which is lighter and far more enduring than an equal bulk of either brick, stone, iron or glass.

KINDRED INTERESTS

The Empire City Electric Company, 15 Dey street, New York, report an ever growing demand for their Helmet brand of wire.

The J. T. Case Engine Company, New Britain, Conn., have issued an illustrated catalogue in pamphlet form, describing the J. T. Case engine.

The Complete Electric Construction Company, 24 Cortlandt street, this city, have gotten out a new water-proof cable connecting box for use on steamships.

The E. P. Gleason Manufacturing Company, 181-189 Mercer street, this city, are enjoying a good business in the supply line. A new factory greatly increases their facilities.

The Tucker Electrical Construction Company, 14-20 Whitehall street, New York, report that they are doing a good Summer business in construction work, with a special demand for the Perkins lamps.

The Minneapolis Exposition management is to be complimented on its advance printing. We have received a very handsome pamphlet in a lithographed cover, which gives many illustrations and facts about Minneapolis.

The Edward P. Allis Company, Milwaukee, Wis., have issued a mammoth illustrated catalogue describing their well-known engine and other products. It is as complete a pamphlet of the kind as we have received in some time.

The Triumph Compound Engine Company, Cincinnati, Ohio, describe their engine in detail in a new illustrated catalogue. This engine embodies new ideas in its construction, and was fully illustrated and described in a recent issue of the ELECTRICAL REVIEW.

The Interior Conduit and Insulation Company, 16-18 Broad street, New York, have gotten out a neat price list of all their appliances for safe interior wiring. Numerous illustrations accompany the text, which includes a code of rules to be observed in putting in the conduits and tubing.

The Weston Electrical Instrument Company, manufacturers of the Weston direct reading standard voltmeters and ammeters, are now thoroughly settled in their new factory, 114 William street, Newark, N. J., and very busy. The demand for these goods is constantly increasing, the natural result of their general excellence.

The Thomson-Houston Factory, at Lynn, Mass., never has been so rushed as at present. There are 38 men at work in the draughting room. In the motor department they have just completed the running gear of 18 street cars, which they are now loading on freight cars for shipment. These go to Wichita, Kan., Cincinnati, British Columbia and other places in Canada.

The Mitchell Vance Company.—The German Liederkranz Society, of New York, have made arrangements for lighting their entire building by electric light. The building was erected about eight years ago, and no provision was made for electric light, but it is now being wired for 1,000 lights. The Mitchell Vance Company have received the contract for altering into combination all of their gas fixtures. Current will be furnished from street service.

Wainwright Manufacturing Co.—Arrangements have been effected by the Wainwright Manufacturing Company, of Massachusetts, with the Taunton Locomotive Manufacturing Company, which will be of great benefit to the former company. The Wainwright Manufacturing Company are selling more than double the number of heaters, condensers and expansion joints they were one year ago, and their plant at Medford is not large enough to meet the demands of their rapidly increasing business. The superior facilities thus secured (the Taunton Locomotive Company being one of the largest manufacturing establishments in New England) will enable them to carry a large stock of goods and fill orders promptly.

PATENT PERFORATED

ELECTRIC BELT.

TESTIMONIAL.

OFFICE OF
THE BRADFORD ELECTRIC LIGHT AND POWER CO.,
OFFICE AND STATION,
Nos. 48 and 50 CHESTNUT STREET,
BRADFORD, PA., Aug. 6th, 1890.

CHAS. A. SCHIEREN & Co.,
Nos. 45-51 Ferry Street,
New York City.

DEAR SIRS:

Will say in reply to yours of July 28th, that we have three of your 10 inch Perforated Belts running alongside of solid ones with far better results. They are easier on bearings, use less oil and are noiseless. As fast as I can, will replace the solid belts with perforated.

Very truly yours,
J. H. ROSE,
Sec'y and Gen'l Manager.

WANTED.—Man to take charge of Detail Department of Electrical Factory. Must be a good mechanic and have had experience in managing men.

Applications should state experience and salary expected.

Address, "G. M.,"

Care of ELECTRICAL REVIEW, New York.

WE offer a large quantity of Stellar Incandescent Lamps, 50-volt, 16 candle-power, for Thomson-Houston sockets. Also 40 Single Arc Waterhouse Lamps in good order, and Line Wire No. 4 B. & S. and No. 2 B. & S., of the Safety Insulated Wire Company and Simplex Wire Company manufacture.

Parties in want of any of the above material, will please communicate with us for prices and particulars.

The Manhattan Electric Light Co., Limited,
80th STREET & AVENUE B, N. Y.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON AUGUST 5, 1890.

433,445 Registering system for telephone exchanges; Joel C. Clark, Morristown, N. J.

433,446 Power transmitting mechanism; William B. Cleveland, Cleveland, O.

433,451 Thermo-electric element; Edward N. Dickerson, New York, N. Y.

433,486 Municipal signal apparatus; Bernice J. Noyes, Boston, Mass.

433,504 Municipal signal apparatus; John C. Wilson and Bernice J. Noyes, Boston, Mass., assignors to the Municipal Signal Co., Portland, Maine.

433,505 Light signal system; John C. Wilson, Boston, Mass., assignor to the Municipal Signal Co., Portland Maine.

433,523 Commutator for dynamos; James W. Easton, New York, N. Y., assignor to P. Mintum Smith, Plainfield, N. J., and Wm. D. Perry, Brooklyn, N. Y.

433,544 Electric Railway; Abraham A. Shobe and Wm. Embley, Jerseyville, Ill.

433,554 Electric release for target traps; Lorenzo L. True, Bismarck, Dakota.

433,557 Dynamo electric machine; Chas. F. Winkler, Troy, N. Y.

433,560 Electric alarm letter box; William B. Detwiler, Radnor, Ohio.

433,561 Cleat for electric wires; Lawrence Furlong, Hartford, Conn., assignor to Frederick C. Rockwell, same place.

433,584 Electric fire alarm and night call; Chas. J. Vining, Cleveland, Ohio.

433,611 Trolley for electric motor cars; Foree Bain, Chicago, Ill.

433,619 Electrical communication; James L. Cutter, Piketon, assignor to Joseph A. Sullivan, Frank O. Loveland and Guy Mallon, Cincinnati, Ohio.

433,636 Multiple switchboard system. 433,917 Method of manufacturing electric conductors; Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Co., same place.

433,637 Electrical measuring Instrument; Edward Weston, Newark, N. J.

433,671 Electric soldering iron; Chas. E. Carpenter, Minneapolis, Minn., assignor to the Carpenter-Nevens Electric Heating Co., same place.

433,687 Electrolier; Everett W. Little, New York, and James T. Robb, Mount Vernon, N. Y.

433,696 Incandescent lamp socket; Thos. G. Roebuck, Jersey City, N. J., assignor to the Pusulite Manufacturing Co., New York, N. Y.

433,700 Alternating current electro-magnetic motor. 433,701 Alternating current motor. 433,702 Electrical transformer or induction device. 433,708 Electro-magnetic motor; Nickola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

433,706 Electric circuit coupling for railway trains; Nathan P. Widdifield, Uxbridge, Ontario, Canada, and Alexander H. Bowman, Allentown, Pa., assignors, by mesne assignments, to the Westinghouse Air Brake Co., Pittsburgh, Pa.

433,738 Galvanic battery; Samuel W. Maquay, Fulham, county of Middlesex, England.

433,744 Electric current controller; Milton O. Sargent, Malden, Mass., assignor of three-fourths to James N. George, Plaiston, N. H., Chas. A. Stearns, Watertown, and Chas. L. Bly, Bradford, Mass.

433,758 Current converting apparatus; Carl Zipernowsky and Maximilian Déri, Buda-Pesth, Austria-Hungary.

433,834 Induction motor; Chas. J. Van Depoele, Lynn, Mass.

433,835 Telegraph key; John B. Van Deusen, Saratoga, N. Y.

433,839 Trolley for electric street cars; Franklin C. Wheeler, St. Joseph, Mo., assignor of one-half to Henry Corbett, same place.

433,851 Device for unloading, recharging and reloading electric car storage batteries; Jacob C. Chamberlain, New York, N. Y.

433,893 Insulating material; John Fottrell, Philadelphia, Pa.

433,895 Release valve for automatic air brakes; Peter Grabler, Allegheny, Pa., assignor to the Westinghouse Air Brake Co., Pittsburgh, Pa.

433,896 Support for electric wires; Albert L. Hallbauer and Edward L. Hiller, Lynn, Mass.

433,903 Electric motor mechanism; Samuel E. Mower, New Haven, Conn., assignor to Henry G. Thompson & Sons, same place.

433,904 Electric motor mechanism; Samuel E. Mower and Geo. J. Spencer, New Haven, Conn., assignors to Henry G. Thompson & Sons, same place.

433,908 Electric arc lamp; Samuel P. Parmly, Chicago, Ill.

433,910 Thermostat for incubators; Frank Saumering, Springfield, Ohio.

433,915 Ceiling block for incandescent electric lamps; Alfred T. Tregurtha, Everett, assignor of one-half to Henry A. Clark, Boston, Mass.

433,919 Electric railway conduit system; Malone Wheless, Nashville, Tenn., assignor, by direct and mesne assignments, to the Wheless Electric Railway Co., Alexandria, Va.

433,920 433,921 433,922 Joint for electrical conductors; Geo. C. Wiley, Arlington, N. J., and Edward G. Acheson, Pittsburgh, Pa., assignors to the Standard Underground Cable Co., Pittsburgh, Pa.

FOR SALE.—50,000 feet, second quality, 2½ and 3 inch creosoted tubing for underground wire work, at 3½ and 4 cents per foot.

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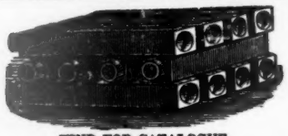
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See Page 19
Why Electricians are bound to have
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IS A SPECIAL TOOL FOR BORING THE
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Send for particulars to the Newark Machine Tool Works,
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IN ADDITION TO A LARGE LINE OF
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THE ELECTRIC GAS LIGHTING CO.

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The "VICTOR," "VICTOR IRON BACK," and "SUCCESS" Wooden Box Bells; the "STANDARD" Iron Frame, and the "CLIMAX" Iron Box Bells; the "BRODIE" LIMITED ALARM and the "LANE" Monitor Bells; the "BEEHIVE" BUZZER and our fine Electric Bell Outfits, all first-class goods.

The "TIRRELL" Gravity Drop Annunciators and Burglar Alarms, for Houses and Hotels, with cases in five distinct styles, are standard instruments in great demand among Electrical Contractors and Fitters all over the country.

The "STAR" Electro-Mechanical Gongs, for Hotels, School Houses, Fire-engine Stations, Stores, Factories, etc., are thoroughly desirable instruments extensively used.

The "O. K.," Nos. I and II Wood Pushes, Nos. 2 and 3 Metal Pushes, new styles in light and dark bronze, N. P. and oxidized silver, finely finished; improved Nos. I and 2 Floor and Nos. I and 2 Pear Shape Pushes; an elegant line of Door Pushes and Pulls, Door Bell Pull Attachments, Presselles, Wall Rosettes, Name Plate Pushes, Desk Buttons and Pushes, Strap Signal Keys, etc., etc.

We also make fine Pocket Galvanometers, Medical Induction Coils without battery, the "SAMSON" Medical Battery, Experimental Induction Coils and Electro-Magnets; Binding Posts in endless variety; Electricians' Pocket Kits, Combination Screw Driver and Nut Wrench, all of best quality and style. Also Sole Manufacturing Agents for the United States of

THE CELEBRATED "SAMSON" (FRENCH) BATTERY,

The most powerful and most enduring Open-circuit Battery in the world.

THE EFFICIENCY OF OUR OWN "DISQUE" LeCLANCHE is fixed and unchangeable; it is, in fact, as good as this style of battery can be made. There is nothing better except the "SAMSON"—that knocks 'em all out!

We are Wholesale Agents for the new "Gethins" Improved Gravity Battery, the best and most economical cell for Fire Alarm and all kinds of Telegraph and Signal Work.

We are always glad to receive either large or small orders, which are promptly filled and shipped to any part of the country. In fact, we generally prefer to sell goods rather than keep them on our store shelves!

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THE ELECTRIC GAS LIGHTING CO.
195 Devonshire Street, Boston, Mass.

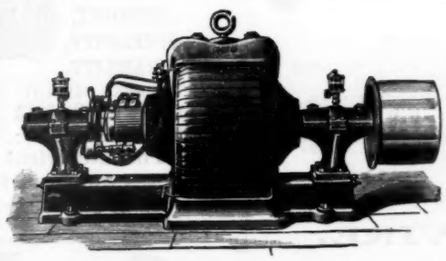
Boston, Aug., 1890.

"C. & C." ELECTRIC MOTORS.

The only Motors in which the magnetic circuit forms a perfect circle around the centre of the armature shaft. Thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth horse-power to 50 horse-power in stock.

OVER 10,000 MOTORS IN ACTUAL OPERATION.



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MOTORS FOR HOISTS AND MINING TRAMWAYS.

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WIRES, CABLES, TAPE & CORD,
—FOR—
PROMPT SHIPMENT.

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IMPROVED
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WINDOW SPRING.
THE BEST.
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ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.
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Door Spring.
Has Shield to Protect the Pin
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

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SAVES BATTERY AND WIRES.

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PATENT WOVEN INSULATED WIRES

SHOW the HIGHEST ABRASION RESISTANCE

OF ANY WIRE MADE.

RE-COVERING OLD WIRES OF ANY MAKE, A SPECIALTY.

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And all Desirable Features.

High Standard of Workmanship,
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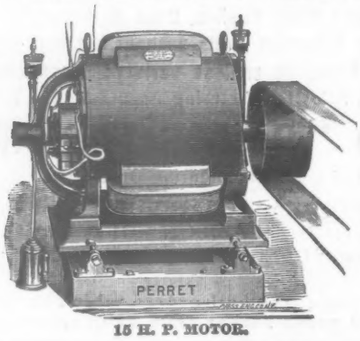
Simplicity.



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Shops, Elevators and Machinery

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Batteries, Wire, Bells, Push-buttons, Flexible Cord, Burglar Alarms, Etc., Etc.

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ECONOMY,
SIMPLICITY,
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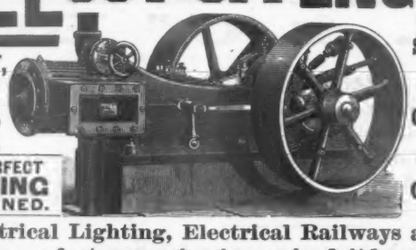
THE MOST PERFECT GOVERNING EVER OBTAINED.



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DOUBLE COMPOUND

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For Electrical Lighting, Electrical Railways and purposes where perfect governing is required, it has no equal.

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GUARANTEED ECONOMY · REGULATION · DURABILITY · SIMPLICITY · SELF-CONTAINED ·

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In Use, Over 2,500.

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RIVER AND RAIL ELECTRIC LIGHT COMPANY

ALDRICH COURT, 45 BROADWAY, N. Y.

* * * * * * * * * * * * * * * * *

THE MAIN ELECTRIC MOTOR

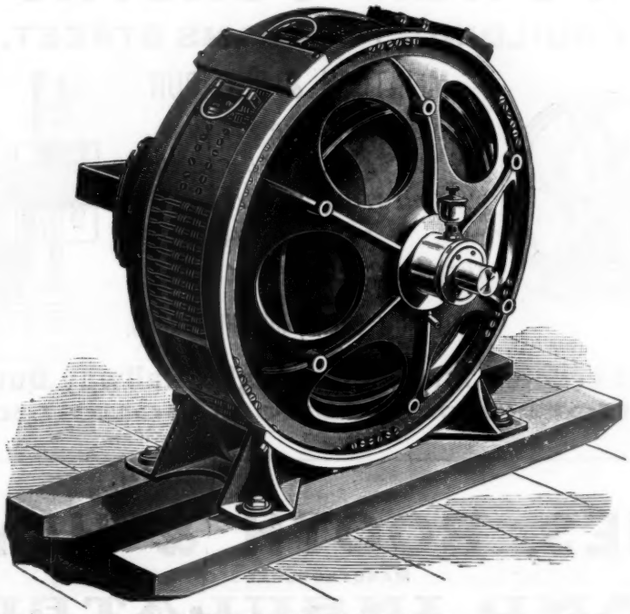
Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.

The Main Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electro-motive force. The battery is adapted to withstand high rates of discharge and rough treatment.



THE RIVER AND RAIL MOTOR.

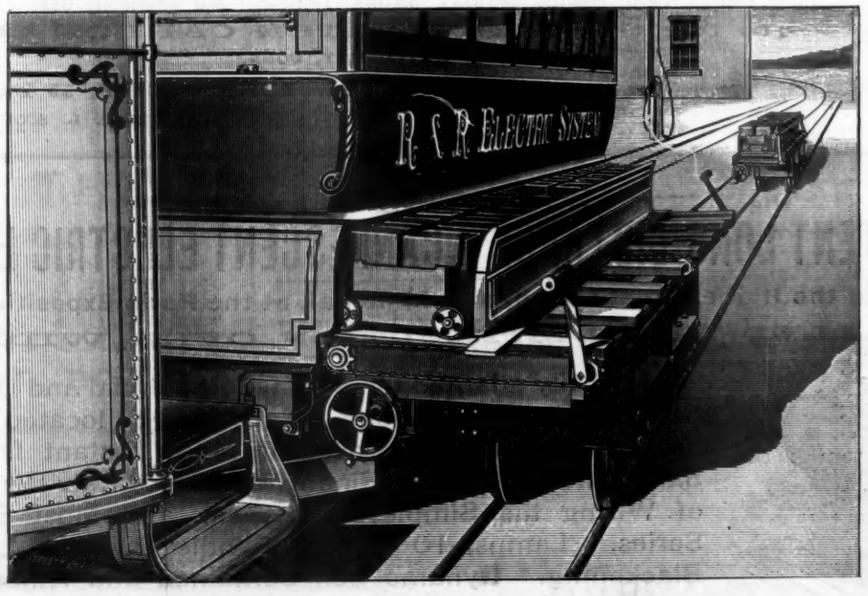
The Car Machinery

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does **NOT** belong to the numerous family of "car starters." The mechanism is quiet in action and durable.



METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

Street Car Companies and Electric Railway Corporations Should Investigate this System.

CARS ARE LIGHTED BY BATTERIES THAT PROPEL THE MOTOR.

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THE ONLY COMPANY IN THE UNITED STATES MAKING AN EXCLUSIVE BUSINESS OF MANUFACTURING

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FOR ALL SYSTEMS.

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Standard and Special Designs for Car, Station and Line Work.
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WESTERN POWER CONSTRUCTION CO.,

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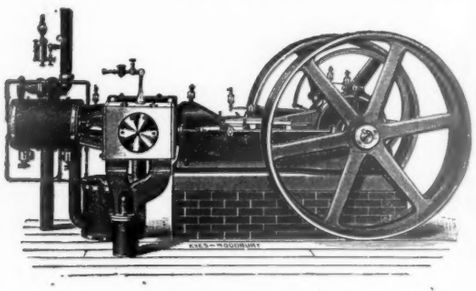

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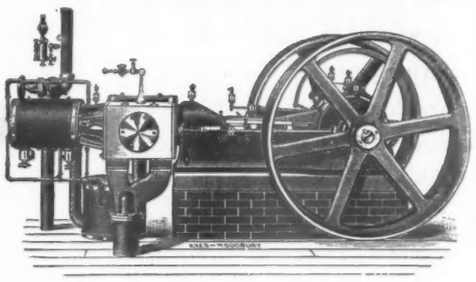
AUTOMATIC RELIEF VALVES.

NOT HOW CHEAP, BUT HOW GOOD.



Complete Steam Plants erected for Electric Light, Railway Duty and Power Purposes.
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Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

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For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

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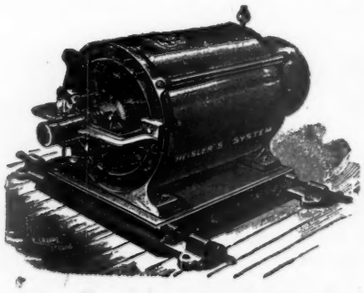
HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM

Awarded the Highest Distinction, a Gold Medal, at the Paris Exposition, 1889.

UNEQUALLED FOR DISTRIBUTION OVER WIDE AREAS.



Specially adapted for Street, Commercial and Domestic Illumination from Central Stations. Plant may be located where Power can be secured Cheapest, even if Miles Distant from the Lighting. Safety, Reliability, and Financial Success fully Demonstrated. Plant of Wiring the Simplest, Cheapest, and Most Efficient. Strictly Series. Lamps, 10 to 100 Candle Power. Long Life without Blackening. Dynamo Self-Contained and Automatic.

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MORE THAN ONE HUNDRED DIFFERENT STREET RAILWAYS IN OPERATION OR IN COURSE OF CONSTRUCTION.
MORE THAN ONE HUNDRED AND SEVENTY-FIVE SEPARATE ORDERS FROM STREET RAILWAYS FOR ELECTRICAL EQUIPMENTS.

The Sprague Electric Railway System has been proved to be the most
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THE CELEBRATED TRINIDAD LINE WIRE. THE HEIMANN FIREPROOF INSULATED WIRE.

House Wire, Underground and Submarine Cables, and Solid System of Underground Wire, Manufactured by this Company.

LIST OF DYNAMOS IN STOCK.

Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,000 c. p. 8 amp. Y	No. Lights 1,300 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in inches.	Belt Speed Required. 5,000 FEET PER MINUTE.	Weight of Dynamo.
C	8	.....	.....	.....	6.5	1¼		530
D	.....	10	.....	25	6.3	1¼		530
E	.....	.....	.....	.....	8.0	2		530
F	16	.....	.....	.....	12.0	2¼		780
G	.....	20	.....	.....	12.5	2½		780
H	.....	.....	26	.....	13.0	2¾		780
I	20	.....	.....	.....	15.0	3		990
J	.....	25	.....	.....	15.6	3		990
K	.....	.....	32	.....	15.0	3		990
L	.....	.....	.....	50	16.0	3		990
M	28	.....	.....	.....	21.0	4½		1,360

Hall Electric Light Co.
404
WEST 27th STREET.
NEW YORK

LIST OF DYNAMOS IN STOCK.

Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,000 c. p. 8 amp. Y	No. Lights 1,300 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in inches.	Belt Speed Required. 5,000 FEET PER MINUTE.	Weight of Dynamo.
G	.....	35	.....	.....	21.0	4		1,360
H	.....	.....	45	.....	21.0	4		1,360
I	.....	.....	.....	70	21.0	4½		1,360
J	40	.....	.....	.....	29.7	6		1,750
K	.....	50	.....	.....	30.0	6		1,750
L	.....	.....	64	.....	29.5	6		1,750
M	62	.....	.....	.....	38.0	8		2,290
N	.....	65	.....	.....	38.6	8		2,250
O	.....	.....	83	.....	38.0	8		2,290
P	64	.....	.....	.....	46.5	10		2,770
Q	.....	80	.....	.....	47.1	10		2,770
R	75	.....	.....	.....	52.5	12		2,300

THE BURTON ELECTRIC HEATER,

FOR ELECTRIC RAILWAY CARS.

No Smoke! No Gases! Economy in Space!

Normal use of Current, THREE AMPERES.

"They are giving us and the public entire satisfaction."—Richmond, Va., U. P. Ry. Co.
"The heat is pleasant, sufficient and economical."—Marlborough, Mass., Street Ry. Co.

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An insulating Waterproof covering for protecting joints and other exposed parts of TELEGRAPH TELEPHONE OR ELECTRIC LIGHT WIRES
MANUFACTURED BY THE BOSTON RUBBER SHOE CO
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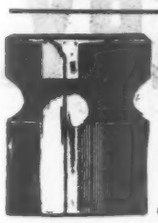

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Our Ware is HARD PORCELAIN, the BODY and GLAZE IDENTICAL, and GUARANTEED NON-CONDUCTIVE for all ELECTRICAL PURPOSES.

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This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

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STRAIGHT LINE ENGINES

A. G. DAY'S OLD RELIABLE INSULATION.

ADAPTED TO ALL ELECTRICAL PURPOSES.

WIRES.

Electric Light and Power, Telegraph and Telephone, Railway and all other branches of Signaling.

The Acknowledged Standard for Durable and High Insulation.

WEATHER-PROOF LINE WIRE.

Insulated with two Kerite Tapes, with Braid Outside and Hard Paint Finish.

TOUGH, DURABLE AND CHEAP.

DAY'S KERITE

CABLES.

Aerial Use, Subterranean Use, Submarine Use, Concealed Wiring in all Locations.

ITS MERITS PROVED BY THIRTY YEARS' USE BY ALL LEADING ELECTRIC COMPANIES.

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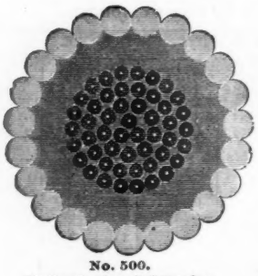
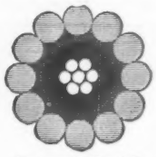
ALWAYS STICKS, NEVER DRIES.

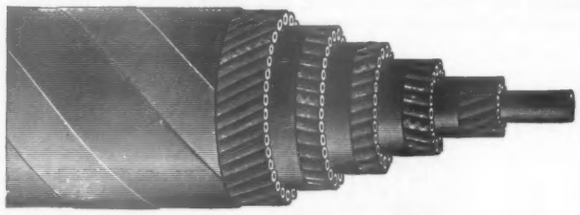
IMITATED BY ALL, BUT EQUALED BY NONE.



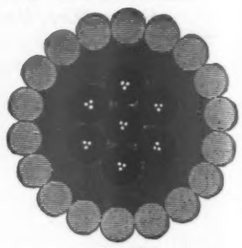
No. 500.
50-Conductor Submarine Cable.
Conductors, each No. 20. Insulation, 3-32. Armor, 23 No. 6.



Armored Electric Light Cable.
Six No. 14 and one No. 13. Insulation, 16-32. Armor, 12 No. 6.



100-Conductor Aerial Telephone Cable.
Conductors, each No. 20. Insulation, 3-32.



No. 73.
7-Conductor Submarine Cable.
Conductors, each 3 No. 18. Insulation, 9-32. Armor, 18 No. 4.

ALL SIZES LEAD ENCASED WIRES.

Underground Electric Light Wire.
Six No. 14 and One No. 13. Insulation, 16-32, Taped.

No. 20 Copper. 3-32 Insulation, Plain.

No 6. Electric Light Wire.
Kerite Insulation and two Braids.

No. 16 Copper. 6-32 Insulation, Braided.

No. 18 Copper for Underground Use.
4-32 Insulation, Lead Encased.

No. 18 Copper.
4-32 Insulation, Plain.

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THE NEW
EDISON-LALANDE BATTERY.

MANUFACTURED UNDER AUTHORITY OF

THOMAS A. EDISON.

Primary Batteries for Telegraph "Mains" and "Locals," Electro-Motors, Electro-Plating, Telephone Transmitters, Electro-Medical Instruments, Annunciators and Burglar Alarms, and all Classes of Closed and Open Circuit Work.

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19 Dey Street, New York.

AUTHORITIES ✣ TALK.

Sir WILLIAM THOMSON, F. R. S., and Dr. JOHN HOPKINSON, F. R. S.,

Versus

Mr. BOTTOMLEY and Mr. HARBER.

ENGLISH EXPERTS' OPINIONS.

Sir WILLIAM THOMSON, F. R. S.

THE UNIVERSITY, GLASGOW, June 19th, 1890.

I have tested the insulation of two specimens of Okonite Wire sent to me recently, and have found thoroughly satisfactory results for all ordinary temperatures and potentials.

The thickness of the Okonite in these specimens was 1.8 millimeters (.072 of an inch), and its insulation held good up to 7,500 volts. After the passing of current through it at this very high potential for some time, I found the insulation resistance for ordinary potentials only reduced from 6,700 (its original value) to 4,500 megohms per statute mile at 16° Cent.

I am well acquainted with Dr. Hopkinson's tests of December, 1886, which were submitted to me early in 1887, and I know the results of his recent tests of the same specimens, showing no deterioration, but actually an improvement in the insulating quality after three and a half years' keeping.

I have also seen the published certificates of many practical men of different dates from March, 1886, to December, 1888, which give trustworthy evidence of the practical success of Okonite Wire for telegraphs, telephones and electric light and power.

With this evidence before me, in addition to my own electric tests and examination of the insulating material in respect to toughness and other mechanical qualities, I believe Okonite to be a very valuable material for the insulation of electric conductors in a large variety of practical uses.

(Signed) WILLIAM THOMSON.

Dr. JOHN HOPKINSON, F. R. S.

WESTMINSTER CHAMBERS, 5 VICTORIA STREET, S. W., June 19th, 1890.

In December, 1886, I made a series of careful and somewhat elaborate experiments upon Okonite Wire, and fully reported upon the same. My report, of which I append a copy, was as complete as it could be at the time. One point it was then impossible to determine, and that, practically, the most important point of all, namely, the question of the durability of the insulation.

It is almost impossible, in most instances, to judge of the suitability of any particular insulating compound for wires until it has stood the test of time for some years. It so happened that samples of Okonite Wire that I tested in 1886 had been left with me and have remained in my possession ever since, parts of the same having been used in my laboratory and for various other purposes.

I have now again tested these samples, and append the tests, together with the results obtained in 1886. In the case of A and C, the test is after one minute's electrification; in the case of B_1 and B_2, the test is a mean during an interval from one-half minute to five and one-half minutes from first electrification; the temperatures are practically the same, viz., 15°C. in 1886, 15°C. now. Samples A and C had been immersed in water for five days, B_1 and B_2 for a shorter time. B_1 is a sample which had been twisted in 1886 for the purpose of ascertaining whether the material would stand mechanical disturbance. B_2 had six kinks made in it for a similar purpose.

A, in 1886	6,180	A, now	7,000	Megohms per statute mile.		
C, in 1886	7,590	C, now	11,680	do	do	do
B_1, in 1886	5,435	B_1, now	11,740	do	do	do
B_2, in 1886	4,750	B_2, now	13,700	do	do	do

In my last report I stated that I was most favorably impressed with the qualities of the wire, both on account of its high insulation and mechanical reliability. Tests on the samples proved that the insulation was practically perfect, both for high and low potentials, and that the insulation would stand very rough handling and a considerable temperature without injury, and, indeed, with but slight reduction of its insulation resistance. I can now add that the result of time has shown that not only is the insulation excellent when made, and that it will stand mechanical disturbance, but that for a term of three and a half years, it is perfectly durable and remains as good as at the first.

(Signed) J. HOPKINSON.

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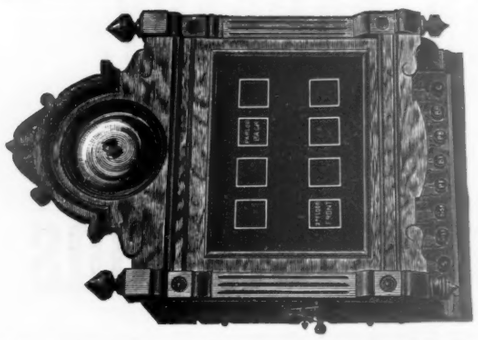

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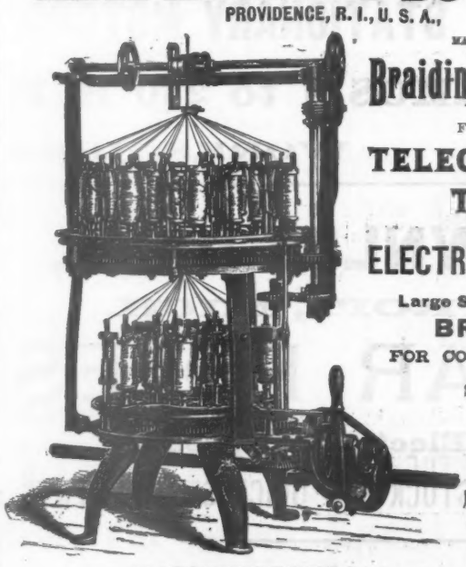

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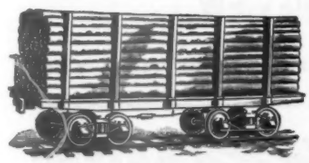
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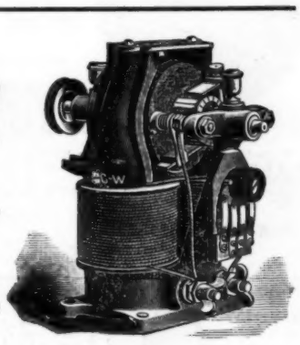

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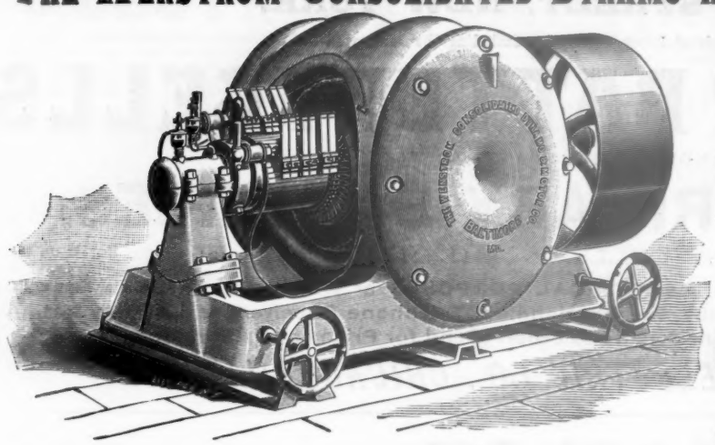

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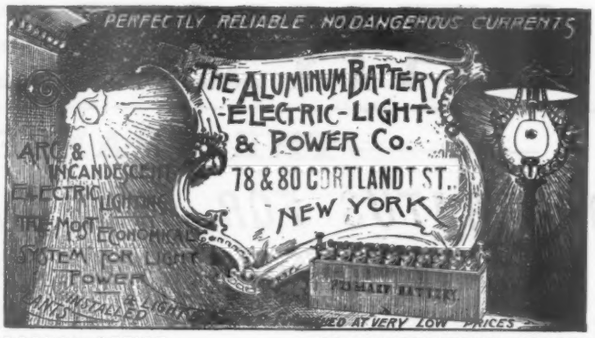
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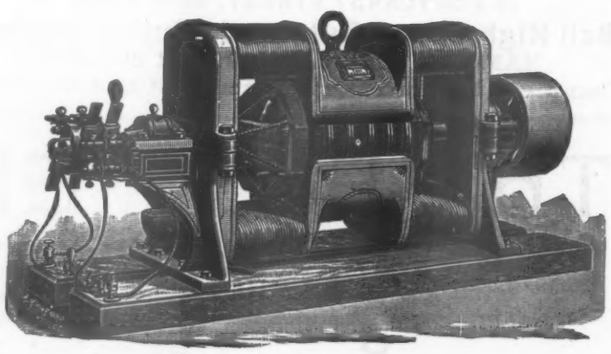

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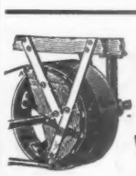

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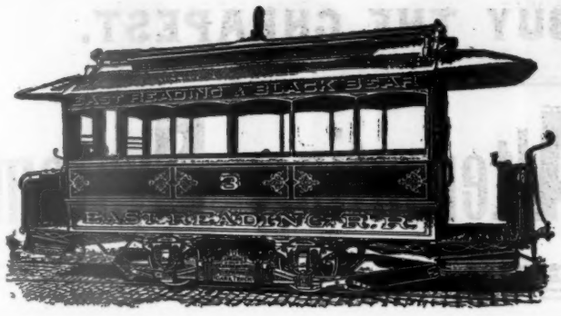

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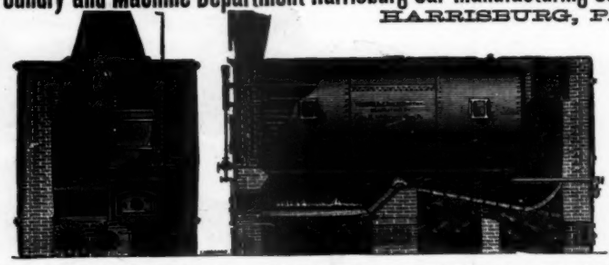

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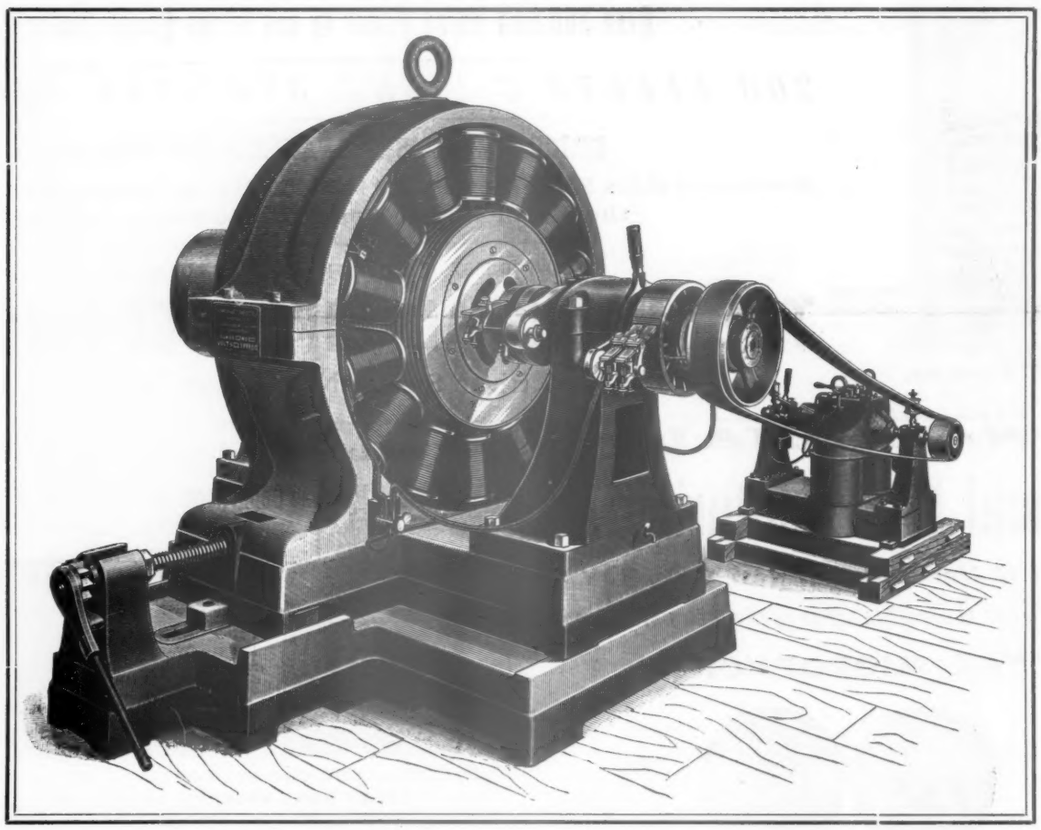

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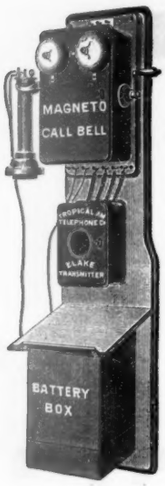

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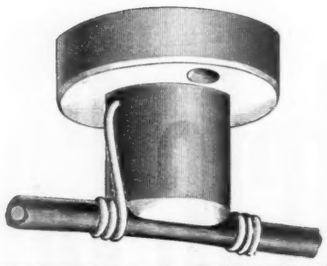

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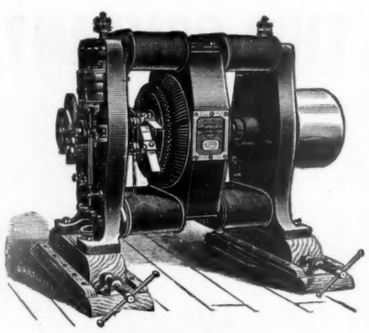

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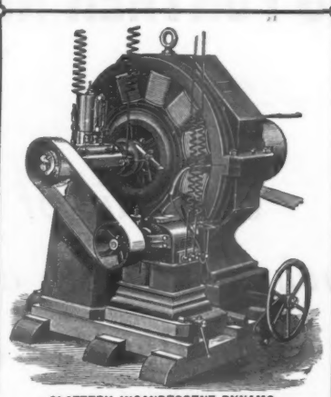

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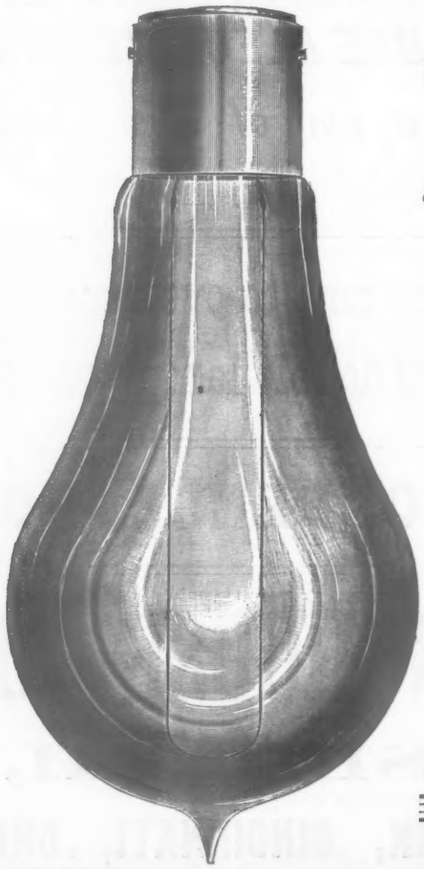

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